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TURNIP AND RAPE SEED PRODUCTION IN NEW ZEALAND.

PART II.—PRODUCTION TECHNIQUE AND SUGGESTED CERTIFICATION.

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IN the first part of this review, which appeared in last month's *Journal*, were discussed certain aspects of seed production from the viewpoint of trade establishment; the present part deals with methods of seed production and the precautions necessary in the maintenance of quality; it also discusses how the Department of Agriculture might effectively co-operate with the proposed industry.

SYSTEMS OF SEED PRODUCTION.

Two methods are commonly adopted in producing roots from which seed is to be harvested. In the first the roots are raised as for an ordinary crop, and are either transplanted during the winter or left to overwinter in the ground and throw up seed-stalks in the spring. Transplanting is expensive, and adopted mainly in the production of special lots of seed, and only the best roots are reserved for seed production. The precaution is taken to bury the roots right up to the neck, as it is claimed that this is an effective means of checking the spread of root rots which normally infect first that part of the root above ground. When the roots are left to overwinter in the ground a certain amount of rogueing may be undertaken, but there is always the danger of loss through disease. One advantage to the grower is that, in case of feed shortage, a proportion of the roots may be pulled, or, in fact, the whole crop used for feed if this is deemed of more importance than the seed crop.

The second and more general method is to sow seed in the autumn—in this country February–March—using 4 lb. of seed or more per acre. The seed crop is raised from the small roots which are produced during the short growing period before winter. Under these circumstances little or no rogueing or selection is possible, and the seed sown must necessarily be of the very highest quality.

Roots raised in this manner may be left in the ground with the minimum of loss through disease, and this is undoubtedly the most economical method of seed production. In Europe, however, seed is often sown thickly in specially prepared beds during late summer and the roots transplanted during winter, continuing throughout this period while weather permits. The advantage of transplanting is in the saving of land, the crop being harvested within six months of planting. Moreover, in certain districts at least, transplanted roots seed more freely than those left in the ground.

Applying this practice to New Zealand conditions, seed would be sown about February–March and the roots transplanted from May to August. In certain districts, such as Central Otago, severe frosts are experienced in April, and early sowing is necessary to allow the plants sufficient time to become established before winter.

Technical Difficulties in Seed Production.

Undoubtedly the greatest technical difficulties are to be found in the maintenance of quality and the avoidance of root rots. A very high standard will have to be attained to satisfy those who have used in the past the high-quality seed imported into this country. This matter is discussed later under the headings of cross-pollination and the production of mother seed.

One might perhaps be permitted to mention here the strict necessity for honesty and care in the treatment of both crop and seed. To the merchant letting contracts the integrity of the grower is of paramount importance.

(1) cross-pollination.

Turnips, swedes, and rape interpollinate, and distance isolation is necessary in order to maintain any degree of purity. The dangers may be summarized as follows:—

(*a*) Swede varieties interpollinate, and turnip varieties interpollinate. It is generally considered that a distance of one half-mile between crops is sufficient to prevent any serious crossing. The distance is liable to modification according to circumstances.

When crossing does take place such characteristics as skin colour, flesh colour, and flower colour are transmitted along definite lines. It is, in fact, possible to predict with a considerable degree of accuracy the colour characteristics resulting from almost any cross. It follows that off-types can be more easily explained, and circumstances that have enabled them to arise may be avoided in the future.

In turnips, red skin and green skin are both dominant to white, and the combination of red and green gives purple([8]). If a white-skinned variety receives pollen from a red-skinned variety the progeny will be red and show up as rogues in the farmer's crop. If the red variety is the mother plant of a similar cross, the progeny will remain red-skinned, and, although the farmer would receive hybrid seed, he is never likely to observe any colour variations in his crop due to this cause. Similarly, white flesh is

dominant to yellow, and flower colour varies according to flesh colour. Variations in flesh colour can then be detected at flowering-time and the rogues removed.

(*b*) Swede and turnip will interpollinate. When the swede is the mother plant the seed produced is plump and viable. The hybrids have large roots, but these are somewhat disfigured by swellings resembling club-root. Such plants may be recognized by their foliage([8]).

When the turnip is the seed-bearing plant and is crossed with swede the resulting seed is small and shrivelled. Sutton([9]) found it extremely difficult to germinate, and had to resort to the use of damp blotting-paper, the seedlings being later transplanted. Roots which develop from this cross with turnip as the mother plant also bear the characteristic malformations similar to club-root. Nelson([10]), in confirming these results, proved that the plants arising from this small seed were weaker and more misshapen than those which resulted from the reciprocal cross. He proved also that, irrespective of the direction in which the cross was made, the hybrids proved to be self-sterile, but that they were capable of pollinating and of being pollinated by other turnips and swedes, and to some extent by other hybrids. In practice, then, the danger is greater when the swede crop is pollinated by turnip.

(*c*) Both swede and turnip will interpollinate with rape and wild turnip. Such crossing would undoubtedly result in serious deterioration, and a distance of at least one mile should separate rape from swede and turnip crops. The wild turnip is perhaps even more serious, and is a menace to the production of swede, turnip, and rape seed. Seed production should not be undertaken in any district in which this weed is prevalent.

Although normally cross-pollinated, swede, rape, and to a lesser extent turnip, are quite readily self-pollinated. The fact that they are self-compatible minimizes the danger attending cross-pollination, for, were they self-sterile, pollen external to the plant would have to be introduced to effect seed production. As Nelson([10]) has expressed it, "In self-compatible plants there may be a bias against crossing due simply to the home pollen being completely effective."

While every precaution must be taken against pollination between varieties and species, yet these precautions are within reasonable practical limits, and the dangers and difficulties should not be overestimated.

Finally, there appears to be no danger of interpollination between members of the kale and cabbage group with those of the swede, turnip, and rape group([9]).

(2) PRODUCTION OF MOTHER SEED.

Commercial turnips and swedes are highly specialized plants resulting from many years of careful selection. It needs constant vigilance on the part of the grower to maintain this high standard. Repeated sowing and harvesting, without any attempt at selection, would result disastrously, apart altogether from the danger of varietal admixture. The tendency would be to bring about the

segregation of heavy-seeding types without any reference to root quality, and it has been proved that high quality in root and bulb is rarely associated with high seed production.

It follows, therefore, that in any progressive scheme allowance must be made for the most careful selection of roots from which to produce mother seed. The mother seed is then used for sowing the commercial crop from which seed is harvested and sold. Modern commercial seed-growing entails the greatest care in the production of mother seed so that the minimum of attention need be paid to the purity and standard of the main seed-crop.

It will hardly be possible to give more than a brief outline of methods suggested for the production of mother seed. In general they follow a system of line-breeding demanding special ability on the part of the grower and the closest possible attention to detail. For this reason it is not usual for the farmer to raise his own mother seed. This service is more generally undertaken by the firm making contracts, and they supply the seed to the grower.

In the first place the roots from which mother seed is to be produced are raised under conditions which enable them to attain full development. This affords material upon which to base selection. The very best roots are then seeded in isolation or, when this is not practicable, they are seeded in the centre of the main crop of the same variety where they are least likely to receive foreign pollen. A little of the seed from each mother root is reserved, and the remainder bulked for the sowing of the main seed-crop.

The small samples of seed reserved from mother roots are kept separate and are sown under conditions most favourable for root development. The lines are compared one with the other, and a further supply of mother roots is obtained from the one or more lines which give the most satisfactory result. The adoption of some such method of selection will result in uniformity of type and the maintenance of quality.

(3) DISEASE.

Roots kept in the ground over winter are liable to several forms of rot. In swedes and certain of the soft-fleshed turnips this is likely to be a serious limiting factor, and it may mean that seed production will have to be limited to certain districts unless the seed is sown in the autumn.

Seed may be sown as late as March, and the small bulbs which are produced before the winter sets in will keep well and seed quite freely in the following summer. Such a practice will not be possible, however, in the raising of mother seed, and no doubt roots for this purpose will have to be raised in more favoured districts.

(4) THE SMALL-BIRD NUISANCE.

Depredation by birds is another limiting factor. A fairly large area was saved for seed in New Zealand about 1917 and 1918, and nearly all the failures recorded were due to the ravages of birds. These attempts would have been entirely successful had it been possible to guard against this danger(4). Small areas were completely ruined, and it was recommended that to be fairly safe from birds crops should not be smaller than 10 to 15 acres.

One certainly takes a risk in reserving an acre or two for seed, and with anything below 10 acres a grower situated in the grain-producing districts must be prepared to take precautions against birds. Areas near plantations should be avoided. Shooting, more particularly in the early morning, seems reasonably effective. Most damage is caused while the pods and seeds are still soft, and on small areas they have little chance of developing past this stage.

How the Department of Agriculture might be able to assist.

In view of the precautions which have to be taken through every stage it is obvious that only the most careful farmers should be entrusted with the production of these seeds. Careful organization and supervision is necessary, and these would certainly be forthcoming were established seed-growing firms to undertake production in New Zealand. Moreover, these firms would require no assistance from the Department of Agriculture, for they have already the full and complete confidence of the farmers of this country.

On the other hand, it might be desirable for the Department to assist in the general supervision of quality and purity, and thus establish a greater degree of confidence in the use of locally produced seed. The Department is an impartial body, and its sole objective in this connection would be to assist the industry. It views the production of turnip, rape, and swede seed as a desirable objective, and is prepared to assist in any way it can. Government certification has in the past introduced an element of confidence into the purchase and sale of certain types of agricultural seeds, and it is considered that a similar state of affairs might reasonably be expected to result from the certification of root seeds. To some extent, at any rate, the trade is relieved of responsibility when they handle seed in sealed sacks to which a Government certification tag is attached, indicating type, and accompanied by an official purity and germination certificate covering viability and weed content.

Suggestions for certification.

Should there be sufficient reason for the inauguration of certification it would have to be undertaken somewhat along the following lines:—

(1) Field inspections would have to be made in winter to determine type-purity and possibly disease-infection. A second inspection at flowering time would be necessary partly to determine impurities as indicated by flower colour, but mainly to be assured that no weeds or crops in the vicinity are likely to affect the varietal purity of the seed which is to be harvested.

(2) Farms would be registered, the seed sealed and branded in the field at threshing-time, and sealed and tagged after machine-dressing. Precautions would have to be taken against the possibility of admixture occurring during threshing and machine-dressing.

(3) Samples would be drawn from the seed the grower intends to sow, and samples would be drawn also of all seed harvested. These samples would be grown probably in three centres—Palmerston North, Lincoln, and Gore—so that it would be possible to arrive at a very accurate decision as to type, purity, and quality.

The growing of the samples drawn from the seed sown by the grower and the submission of reports thereon requires further explanation. Samples would have to be submitted by the end of September and reports would be available within four or five months. It may be pointed out that there might be three classes of growers to cater for—

(*a*) The grower who sows at the usual time to obtain a root crop so that he may feed part or the whole of his crop or reserve it for seed in the following season, according to circumstances. Such growers would receive a report in ample time to enable them to feed off the crop should the sample trial report indicate that for seed production the crop is not up to the required standard.

(*b*) There will be the grower who sows in February–March. Such a crop would be of no use for stock-feed, but if a sample of the seed he intends to sow is put under trial in the spring a report would be available before he needs to sow. Thus he would be saved the risk of growing a crop that could be used neither for stock-feed nor seed production.

(*c*) Finally, there is the case of the grower who raises mother seed which he harvests in December–January and uses for sowing the main seed-crop in February–March. In this case there would be no opportunity for a sample trial report being available before sowing. Nevertheless a report would be available before the seed crop is harvested, and it would then have been determined (in so far as the sample trial affects the position) whether the seed should or should not be accepted under certification.

Virtually the same position would arise in the case of rape. Samples of seed to be sown would be grown and type determined. Results of this trial would be ready by December, and would give the grower ample opportunity to decide what best to do, whether to graze the crop right out or graze lightly and reserve for seed.

PRODUCTION OF MOTHER-SEED BULBS.

Further, the Department might possibly undertake a service in the production of mother-seed bulbs for firms or individual growers who are not sufficiently confident to make these selections themselves or whose farms are located in districts unsuitable for the production of these roots. Were this service undertaken it might involve the Department in considerable expense, which would, as in the case of certification, be recovered by making adequate charges. It would certainly result in uniformity of selection and a corresponding uniformity in the product.

Conclusion.

It cannot be said that this review is based upon a very extensive experience in the production of turnip and rape seed in New Zealand. Possibly there are difficulties to which no reference has been made, but one is inclined to think that they are not insurmountable. The difficulties lie, if anywhere, in economic production and distribution, in the maintenance of quality, and the avoidance of disease. If we agree that these are not insurmountable, then the way is open for those who are to take part in the development of this industry in New Zealand.

The writer is particularly indebted to Mr. J. S. Hunt, of Maungawera, Central Otago, for his advice in the preparation of this review. Mr. Hunt has had much experience and is at the present time actively engaged in the production of turnip and swede seed. Mr. R. B. Tennent, Fields Superintendent, Department of Agriculture, Dunedin, and Mr. W. W. Mullholland, of Darfield, have both offered helpful criticism, and their assistance in this connection is gratefully acknowledged.

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THE NAPIER-AHURIRI LAGOON LANDS.

A SURVEY OF SOILS AND THEIR PLANT ASSOCIATIONS.

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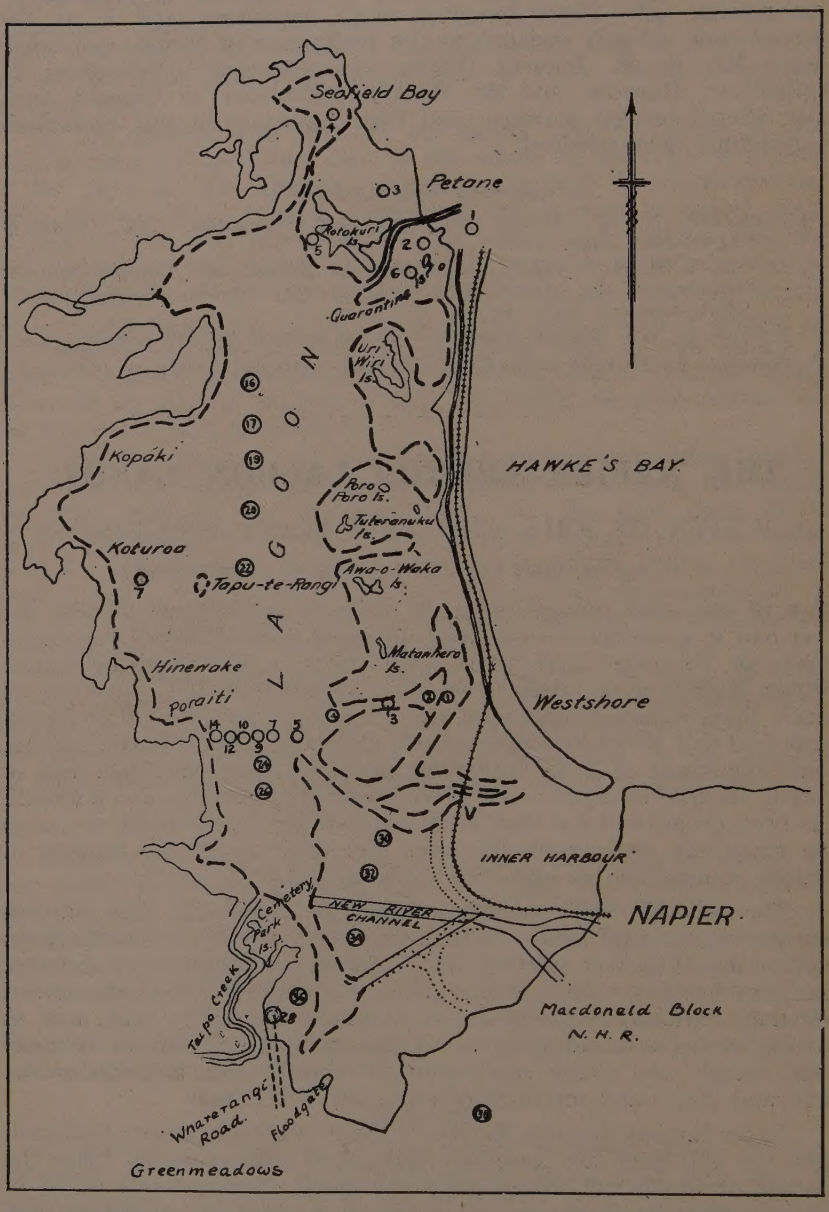
ONE of the most remarkable areas that an agricultural chemist has ever had to investigate is the land upheaved in the Hawke's Bay earthquake of February, 1931, when large tracts in the populous coastal Napier district were raised about 6 ft., resulting in the conversion of much shallow lagoon and mud flat subject to periodical flooding by fresh and salt water into permanently dry land. The Ahuriri Lagoon, some thousands of acres in extent, much used for yachting, was so greatly reduced in depth as to be useless for that purpose, and a scheme has been projected by a local civil engineer, Mr. G. Rochfort, to pump the remaining water from this area and drain it for the purpose of making it available as high-class farming-land.

The soils of reclaimed sea marshes are noted for their varying texture within small areas. Wind and water currents no doubt always play a great part in sorting and redepositing material of different grades of fineness, so that when drained the texture of the consolidated soil may be anything between the extremes of sand or clay, and as texture is the dominating factor in determining agricultural value in soils, shingle and coarse sands form the poorer soils and fine sands, silts, and clays, and mixtures of these the richer soils.

In the famous Romney Marshes in Kent, originally largely reclaimed from the sea, there are fattening fields often surrounded by lands the pasture of which will merely keep the sheep growing, or may be fit only for breeding upon, the soil being as a whole by no means even in quality and a certain amount consisting of thin poor soil (Hall and Russell, 1912). Again, in the great drainage scheme undertaken by the Dutch Government in the reclamation of the Zuider Zee the resulting land is very variable in texture, ranging from very heavy clay to nearly pure sand.



MAP OF AHURIRI LAGOON, SHOWING LOCATION OF SOIL-SAMPLES TAKEN IN MAY AND JULY, 1932.

The broken line - - - - within the original margin of the lagoon indicates the new water-line consequent on the earthquake.

[*From a plan by G. Rochfort.*

The matter is not easily dismissed as being merely the difference between good and poor soil, for in the heaviest soils the bad effect of prolonged contact with the sodium salts of the sea-water results in a defect which has to be cautiously dealt with, or the result may be disastrous to the subsequent use of the soil. The sodium clay which exists in the sea-bottom mud must be changed into a calcium-magnesium clay on the consolidation into reclaimed land. In many littoral areas there is sufficient calcium in the soil in the shape of shells to decompose the sodium clay, sodium bicarbonate being washed away in the drainage, but where attempts to work sodium clay in agricultural operations have been made the result not only ends in failure, but may make the land untillable for a number of years. The critical time for reclaimed lands is sometimes not until the surplus sodium chloride, a flocculating agent, has been washed away and sodium carbonate, a deflocculent, is liberated.

The transformation of sodium clay must take place under the influence of the bicarbonate of lime in the soil, calcium clay being formed, and sodium bicarbonate eliminated as rapidly as possible in the drainage-water. Abundant carbon dioxide in the soil and a high permeability of soil are indispensable for the success of this reaction. This matter has been explained at some length, because the difficulty of dealing with sodium clay has already been experienced on the Hauraki Plains to such an extent as to demonstrate the importance of eliminating the danger at the earliest stage possible in all reclamation work. Every endeavour should therefore be made to obtain good permeability of soil for water and air, or where this already exists to retain it and on no account to diminish it by excessive or faulty tillage. Drainage-water should be led away quickly by good systems; the ploughing should be judicious, taking care that wet ground is never ploughed until the sodium clay has been transformed (Hissink, 1932).

In order to understand the difficulties in advising the Napier Harbour Board on the possibility of converting some thousands of acres of unoccupied land which, previous to the earthquake, was so much within the influence of the highest sea tides and flooded rivers that it was negligible as a land asset, consisting of shingle and sand beach, salt mud-flat or marsh or shallow salt-water lagoon, the following details may be given.

The lagoon before the earthquake was about 10 ft. deep and 7,000 acres in extent, being merely separated from the Pacific Ocean by a shingle-sand bank which extended from the Bluff Hill to Tangoio, a distance of about thirty miles, and along the Napier end of which there had grown up quite a small town of residences, week-end cottages, and whares, together with sports clubs and a good hotel. Jetties running into the lagoon and previously used for yachting serve now but to indicate the extent of the recession of the waters, the piles being permanently high and dry.

There seems reason to believe that it is possible for the sea-water to percolate from the ocean through the shingle bank to the subsoil below the lagoon bottom, but this bottom is composed of a layer of very fluid mud on top and gradually becoming more compact on deepening, so that the salt water, if below, does not percolate upwards, for the waters at present are only very slightly brackish.

The bottom of the lagoon at present is a mass of material, mostly mineral, which is impervious and deficient in organic matter, thereby differing from a fertile soil, which is dependent on porosity for the circulation of air and water needed by land plants. Fertile soils have a crumb-like structure, the individual crumbs being made up of smaller particles. The action of certain chemical salts, such as carbonate of soda, is to disrupt these soil crumbs and break them down into their constituent particles. The soil where the number of fine particles is very large—*e.g.*, clays—may be rendered unworkable by soda, a wet tenacious mass resulting which cannot be tilled, and which in hot seasons dries out to something of the nature of a sun-dried brick. A heavy soil once damaged by puddling is best left to itself, when alternate wetting and drying would in time restore the crumb-like structure, a condition brought about more quickly by alternate freezing and thawing. It will thus be seen that a soil so damaged is somewhat of a problem to the farmer who wishes to hasten the production. Fortunately, New Zealand soils, especially those of the North Island, are for the most part light loams, and therefore can be worked in any weather. It is, however, in the estuarial lands or those reclaimed from estuaries where heavy clay soils are usually found.

It thus became necessary to ascertain the texture of these Napier upheaved lands in order to determine whether in great part they were unusually heavy, and to do this to examine not only the dry area, but also those parts now covered by the lagoon waters, a matter of some difficulty, since the bottom consisted of what might be called a quick-mud in which any one not cautious enough to test the foothold before wading might be engulfed.

The main areas for the purpose of preliminary consideration may be roughly classified as—

(1) The shingle and sand bank dividing the ocean from the lagoon (Analysis No. C/445). (See table, page 74.)

(2) The area at present drying and cracking up, but barren of vegetable life with the exception of halophytes and salt-marsh plants (Field Nos. 6, 7, 30, 36, 38).

(3) The ground from which the salt has been washed and in which the halophytes are in process of being smothered by useful forage plants (Field No. 28).

(4) The areas at present below from 1 ft. to 3 ft. of water, only slightly brackish (Field Nos. 16–26, 1–14).

Three visits were paid to Hawke's Bay by the writer, the first on 31st May, 1932, when two days were spent in taking samples of the elevated mud-flats and other parts where they could be safely obtained without the use of a boat. The analyses of these samples showed that there was every hope that the tracts sampled might become eventually high-class producing soils. The greater area still remained under water, and could not be sampled without special provision, which having been duly authorized, a further visit was paid on 19th July, when the remainder of the areas were carefully sampled with the aid of a boat and crew. Napier was again visited on 3rd January, 1933, and further samples taken.

The mechanical analyses proved that the samples fell into the following categories. May visit: Topsoils from North end—

Loams, 2; fine sandy loams, 2; silt loams, 2; sandy clay, 1. Where possible to take them the subsoils of these proved to be all fine sandy loams. July visit: Topsoils from under-water areas and south end—Loams, 2; sandy loams, 2; coarse sands, 2; fine sandy loams, 3; silt loams, 7; sandy soils, 1; silt clays, 3; loamy silts, 2; fine sandy silt, 1; coarse sand, 1. The subsoils of these consisted of fine sandy loams, 3; loams, 2; silt loams, 4; sandy loams, 2; fine sandy silt, 1; fine sand, 1; loamy silts, 3; coarse sand, 1.

It will thus be seen that the soils and the subsoils are composed of materials in those proportions which would on draining and drying consolidate into permeable free-working soils, and which would, owing to the fact that except where sand or shell beds prevail they would crack up and permit free percolation of rain and flood waters into the drainage-channels, carry off the injurious sea salts and soluble salts derived from them, and result in excellent soils. The tendency is generally for the subsoil to be more coarse-textured than the topsoil, and this is another good feature in the analyses. The entire absence of material which would on reclamation form a heavy soil such as a clay is to be noted also as a most favourable feature.

Some Details of the Survey.

Dry-land Soils at North End of Lagoon.—At the extreme northern end of the lagoon a nearly pure association—the term given to a community of plants containing only one species—of maritime rush (*Juncus maritimus*), which is able to tolerate periodical flooding by sea-water, is found in rather large areas, probably in the aggregate some 250 acres, but not large enough to warrant being called a main type of the lands inspected. This rush is decidedly the dominant growth, but with it in places are associated other salt-tolerating species of tall growth, notably a shrub, the sea-marsh ribbonwood (*Plagianthus divaricatus*), and a few smaller growths.

An important immigrant to the rush association which may, although in small quantities at present, spread extensively and become a nuisance is tall fescue. This type of soil was the first to be utilized of the raised lands, a 40-acre privately-owned paddock having been cultivated and borne a crop of Cape barley, which had been eaten off by stock. Judging by the stubble remaining at the time of the writer's first visit in May, 1932, the crop was a fair one, considering it had been sown on the first furrow out of waste estuarial lands* (see sample C/195). This type shades off into a slightly lighter one of fine sandy loam and sandy clay similarly populated (C/197, C/199) with this rush as a dominant growth, all three areas containing within 1 per cent. of salt and all remarkably high in available phosphoric acid, being about three and a half times in this latter constituent as are ordinary farm soils. This is a very strong reason why the *juncetum*, as rush-covered lands are called by ecologists, should be first utilized in reclamation schemes,

* An instance is given with photograph in *Nature* (16/7/32) of Zuider Zee land from which the sea-water was pumped in June, 1930, giving a crop of rye-corn in 1932.

Chemical Analyses of Napier-Ahuriri Lagoon Soils.

Results, except *, are percentages on soil dried at 100° C.

Laboratory No.	Locality, Plant Association, Field No., &c.	Volatile Matter.			Total Nitrogen.	1-per-cent. Citric-acid Extract, Dyer's Method, Hall's Modification. ("Available Plant-food.")				Hydrochloric-acid Extract. ("Total Plant-food.")				Sodium Chloride.	*pH.	CO_2.	Soil Texture.
		*On Air-drying.	*At 100° C.	On Ignition.		Lime, CaO.	Magnesia, MgO.	Potash, K_2O.	Phosphoric Acid, P_2O_5.	Lime, CaO.	Magnesia, MgO.	Potash, K_2O.	Phosphoric Acid, P_2O_5.	NaCl.			
C/195	(1) Cape barley paddock ..	36·7	4·7	9·1	0·269	0·233	0·193	0·053	0·035	1·18	1·62	0·99	0·11	0·38	7·6	0·11	Loam.
C/197	(2) Maritime rush covering ..	25·7	2·0	4·0	0·097	0·235	0·130	0·037	0·034	1·37	1·35	0·79	0·10	0·35	8·0	0·12	Fine sandy loam.
C/199	(3) Pure rush covering, north of No. C/197	36·0	4·1	5·0	0·134	0·133	0·150	0·058	0·036	1·15	1·33	0·85	0·10	0·95	7·4	0·02	Sandy clay.
C/201	(4) Seafield Bay, shell bed ..	23·2	3·1	3·7	0·068	0·868	0·209	0·078	0·018	2·12	1·30	0·82	0·07	1·00	8·4	0·70	Fine sandy loam.
C/203	(5) Karaka Bay, flats	30·0	5·3	7·6	0·087	2·700	0·327	0·092	0·024	3·89	1·52	1·05	0·10	0·87	8·6	2·25	Loam.
C/205	(6) Quarantine Island, cracked flats, barren	32·6	5·2	7·6	0·229	0·629	0·213	0·104	0·020	1·75	1·66	1·15	0·09	1·04	6·2	0·36	Silt loam.
C/207	(7) South-west side, barren flats ..	32·8	4·2	5·2	0·085	1·759	0·278	0·095	0·026	2·97	1·58	1·04	0·11	0·86	8·5	1·49	Silt loam.
C/374	(28) Salicornia - melilot association, Park Island Road	24·4	2·8	6·0	0·200	..	..	..	0·022	1·66	1·57	0·87	0·10	0·49	..	0·21	Loamy silt.
C/376	(30) Mud flat, barren, Park Island Road	14·8	1·8	1·5	0·043	..	..	..	0·014	2·12	1·01	0·82	0·08	1·81	..	0·75	Fine sandy silt.
C/378	(32) Cotula flat, Park Island Road	33·3	3·9	5·1	0·090	..	..	..	0·026	2·18	1·85	1·32	0·13	0·69	..	0·82	Silt loam.
C/380	(34) Scirpus flat, Park Island Road	22·7	2·0	3·6	0·060	..	..	..	0·018	2·35	1·34	0·91	0·07	0·39	..	0·85	Fine sandy loam.
C/382	(36) Cracked flat, Park Island Road	30·4	3·4	4·4	0·094	..	..	..	0·020	2·06	1·49	0·95	0·07	0·80	..	0·51	Fine sandy loam.
C/384	(38) Halophyte flat, MacDonald Block	43·9	7·4	9·3	0·248	..	..	..	..	3·64	2·01	1·24	0·05	1·91	..	1·59	Silt clay.
C/445	Sand beach, Westshore	..	0·2	1·1	0·020	..	..	..	0·008	5·67	0·70	0·30	0·05	..	..	4·75	Coarse sand.†
C/496	C/353 (7), C/354 (8), C/356 (10), C/358 (12), C/372 (26)	..	3·9	5·1	0·092	..	..	..	0·025	2·61	1·79	1·10	0·07	..	..	1·15	Silt loam.
C/497	C/349 (3), C/351 (5), C/368 (22) ..	..	2·3	3·7	0·056	..	..	..	0·016	3·98	1·33	0·85	0·09	..	..	2·48	Sandy loam.
C/498	C/350 (4), C/362 (16), C/365 (19) ..	..	0·5	2·5	0·034	..	..	..	0·009	4·58	0·90	0·64	0·05	..	..	2·84	Sand.
C/499	C/347 (1), C/348 (2)	..	3·1	4·3	0·076	..	..	..	0·019	4·16	1·54	0·98	0·09	..	..	2·80	Loam.
C/500	C/363 (17), C/366 (20)	..	3·8	5·7	0·101	..	..	..	0·028	2·38	2·05	1·20	0·08	..	..	0·99	Silt clay.

† Mixed with 35 per cent. of stones and gravel.

[*Analyst, F. J. A. Brogan.*

Notes.—Samples C/195 to C/207 were taken on 31st May, 1932, the remainder on 20th July. The subsoils of C/195, 197, 199, 201, 203, and 205 are all fine sandy loams. C/446, subsoil of C/445, is a coarse sand. The composite samples C/496 to C/500 were made from samples taken under water.

for if this rich land is allowed to remain as waste ground, undesirable growth such as tall fescue is likely to invade it, rendering the subsequent bringing-in more difficult. Possibly the tall rush has proved an attractive shelter for forms of life which have resulted in production of much available phosphate.

The other tracts of dry land, grouped round the former Quarantine and Rotokuri Islands, are represented by samples C/201, C/203, C/205, either loams, fine sandy loams, or silt loams; the areas consist of flats sometimes cracked and fissured in all directions on drying, and sometimes largely shell beds. Sea-shells have evidently had a great influence on the composition of this area, devoid for the most part of any but the most halophytic plants such as *Salicornia*, for the percentage of carbonate of lime is usually high and here the land is not cracked, but where the land contained little shell it has cracked extensively. There is no doubt that all the land round these islands at present dry could and should be brought into cultivation without delay. A visit paid in January last showed that the area under water was rapidly shrinking through the lagoon drying up, and a self-sown crop of rauriki or sow thistle (*Sonchus* sp.) from wind-borne seed had grown and had been eaten off by sheep on some of the cracked land. It will be noted that these areas, so recently colonized by dry-land plants, among which are *Salicornia australis*, *Cotula coronopifolia*, *Atropis stricta*, and the exotic *Plantago coronopus* are characterized by the lower available phosphate content and the higher lime and potash content, but there is still plenty of phosphate for ordinary crop needs, and the land should give good results with any crop capable of tolerating about 1 per cent. of common salt in the soil.

Kopaki and Koturoa, or South-western Side of the Lagoon.—The analysis of samples drawn on the flats of the area represented by C/207 showed that it was a silt loam of similar composition to much of the flat land round the northern islands, but the waters had so recently receded that no land-plant colonization had taken place.

Flats at Southern End of Lagoon.—At the extreme southern end of the lagoon occurs a very large area of flats of variable nature, both in the plant-covering and in the texture of the soils. These are represented by samples C/374, C/376, C/378, C/380, C/382.

This area contains spaces quite barren of plant life, in which case it contains a large amount of salt, nearly 2 per cent., or spaces rapidly becoming populated by various plants. Those tracts where the salt had been washed out most effectually were those which supported the most valuable growth. Thus, when the salt is less than 0·5 per cent. an exotic legume, *Melilotus*, was often the dominant growth, smothering the salt weed, or else the growth consisted of a sedge *Scirpus maritimus* (Purua grass), a tall quick-growing sedge which is useful as a fattening fodder for cattle. *Cotula coronopifolia*, an indigenous plant, seems to flourish in areas where the salt has been only partially washed out, and was present in amounts between 0·5 per cent. and 0·7 per cent. of sodium chloride. The *Salicornia australis* (Australian glasswort or salt-weed) flourished where the salt content was from 1·5 per cent. and upwards. It may therefore be possible to predict the relative saltiness of the soil from a mere inspection of the plant covering. It seems certain that the salt-weed will disappear as soon as the salt content of

the soil sinks below a certain concentration, when plants which cannot grow in presence of 1·5 per cent. or more of salt and are taller and quicker-growing will smother the salt-weed. The flats in the south end contain about 1,500 acres of rather variable land. This part is bisected by the New River channel, and in the past has been subject to fresh-water floods coming from the Tutaekuri River, the nature of the deposit being more that of a river-silt than of a maritime deposit.

This river-silt was subject to strong winds blowing from the north-west, and therefore its barrenness in places may be due to the mobile character of the surface soil. Tall fescue is again in evidence in this area in *Juncus maritimus* associations. An inspection of this flat showed that it was most rapidly changing from a salt-water to a fresh-water area, marine growth disappearing and being succeeded by lacustrine growth, salt-loving plants and animals both disappearing and being succeeded by those found in fresh water.

This area is separated from another important one on the south side by the main road and known as the MacDonald Block, about 500 acres, which had rather a different history. Apparently this block was subjected to sea flooding at intervals, with subsequent slow drying out, and the result has been increasing saltiness due to sulphates rather than chlorides, the latter having been washed out and the sulphates remaining in the soil. All marine animal life had gone in the MacDonald Block in May, and the appearance was the most lifeless of all the raised lands visited. The waters in the cracks were the saltest of any met with, and the general sterility of the land is probably due to the poisonous magnesium sulphate. Two plants were most conspicuous by their presence, the salt-weed *Salicornia*, and *Chenopodium glaucum*, an annual salt-bush. Apparently these were the main plants able to resist the excessive amounts of sulphates, one of which, magnesium sulphate, was present to the extent of about 0·5 per cent.; but in the interval between the July and January visits this block had been flooded by fresh water, which had all disappeared, even from the cracks, by January, which no doubt resulted in the removal of a further quantity of poisonous magnesium salt.

At the time of the January visit the worst areas were rapidly becoming covered by the seedlings from *Chenopodium*. Parts of this have been recently leased, and lessees are plouging in the salt-weed with the intention of sowing grasses. The soil covered with the remains of a mass of salt-weed which was quite dead (C/876) contained only 1·12 per cent. of common salt, but where it was green and flourishing (C/880) it contained 1·68 per cent. This land was being ploughed, and it would be very interesting to watch the outcome of the grass-seeding of this block (No. 1). On the other hand, Block No. 4 (C/878), growing *Scirpus maritimus*, contained only 0·72 per cent. of salt. Thus four soil-samples from the MacDonald Block taken in January, 1933, C/876–880, contained only from 0·72 to 1·68 per cent. of sodium chloride, but a sample taken in July had 1·91 per cent.; the magnesium sulphate, previously 0·6, had sunk to between 0·2 and 0·4 per cent.; and the other sulphates from 0·75 to between 0·11 and 0·46 per cent.

The Underwater Areas.—Samples from these were drawn from a boat in the positions shown on the map. The analyses indicated that no sample was finer in texture than a silt clay, and there were

only two samples of these, the greater part of the bottom varying in texture from a silt loam to a sand. The various grades of unconsolidated material were classified, composite samples of each grade made, and these analysed under the numbers C/496 to C/500, with the results shown in the accompanying table. The sands are the poorest in plant-food, but all the other grades of material are rich in mineral plant-food, especially so in lime, phosphate, potash, and magnesia. This lagoon-bottom material cannot be regarded as a soil until it has been drained and has consolidated and acquired the peculiar texture and constitution common to fertile soils.

The Gravel-sand Beaches.—This is the coarsest type of material uplifted (represented by sample No. C/445) and is merely an extension of the beach which cuts off the lagoon lands from the ocean. Analyses show that this so-called shingle is really a mixture of shingle and sand, for after 30 per cent. of stones and gravel has been sieved off the remainder contains 80 per cent. of fine and coarse sand, with a good proportion of shell fragments in both soil and subsoil. Chemical analysis shows that the sand compares favourably with the Manawatu dune sands, which are easily grassed when the mobility has been overcome, and produce good pasture. Here the stones and gravel would prevent the wind causing excessive mobility, and the raised beaches would no doubt support special crops such as lucerne, silver-beet, &c., and provide ground for soiling crops and even grazing. Silver-beet has spread itself in many places, forming perennial mounds of succulent dark-green leaves.

The sudden uplift of land exposed the sea-bottom and many fixed forms of life, which provided a feast for birds. Most conspicuous was a giant bivalve, the horse mussel (*Pinna*), now for the first time seen in its natural attitude, not lying along the sea bottom, but standing bolt upright poised on the smaller end of the shell, about 1 ft. in height, and providing the most striking feature of the mud flats. Flocks of land birds as well as of sea birds profited by the rich feast of marine growth exposed and left seeds of some berried plants to germinate on the gravel beaches. Prominent is the African box-thorn (*Lycium horridum*), which is forming young thickets and would yield a supply of young plants for hedges.

(To be continued.)

Abscesses in Pigs.—This matter is referred to in the annual report of the Live-stock Division for 1931-32 as follows: "An analysis of the monthly returns of the Meat Inspectors at the various freezing-works shows that a considerable number of pig carcasses are condemned either in part or as a whole for abscesses, particularly in the scrotal region. The loss sustained from this cause alone is considerable, and, seeing that it could be avoided, it is in the interest of every pig-breeder to do so. These abscesses are caused by organisms gaining entrance either at the time castration is performed or subsequent thereto. The greatest care should be exercised to see that the hands of the operator and the instruments used are thoroughly cleansed and made sterile. After the operation is finished the wounds should be dressed with a suitable antiseptic and the animals kept under the cleanliest conditions possible until the wounds have healed completely. If care were exercised in this direction it would obviate the necessity for condemning many pig carcasses which in every other respect are capable of being made into a first-class article."

STRAIN INVESTIGATION OF WHITE CLOVER.

FINALIZED RESULTS OF TRIALS AT PLANT RESEARCH STATION.

E. Bruce Levy, Agrostologist, and L. W. Gorman, Assistant in Agrostology, Plant Research Station, Department of Agriculture, Palmerston North.

In this *Journal* for February and March, 1931, were outlined the preliminary results of the strain work on white clover undertaken at the Plant Research Station at Palmerston North.* The trials referred to have completed a three-year test and the results may now be finalized. The trial consisted of two parts—(1) a single-plant study of some 3,360 plants representing sixty-two lines planted out 2 ft. apart each way, and (2) broadcast trials involving 630 commercial lines of white clover seed, both of New Zealand origin and imported.

From the commencement to the finalization of the three-year trial the New Zealand No. 1 white clover type was outstanding in yield, long seasonal spread of growth, and persistency, and no other type of white clover maintained itself so free of volunteer grasses and weeds (Fig. 1). The soil on which the tests were conducted was by no means uniform, but on the poorer aspects (although giving there a reduced yield) as well as on the more fertile aspects, New Zealand No. 1 did better than any other white clover on the same soil-type.

Plot Trials.

The broadcast plots were not grazed over the period, but were cut periodically at a 6 in. to 8 in. stage with a scythe, and virtually no reseeding took place on the area. High soil fertility was maintained by periodic top-dressing with superphosphate. This style of management may have favoured the New Zealand No. 1 type over all others because of the robust growth and strong competitive nature of this type, as against one, such as the Kentish Wild White, which is readily smothered if competitive growth is allowed to grow too tall. Then again, those free-seeding, non-persistent types are at a disadvantage under periodical cutting that prevents reseeding and tall growth which inhibits re-establishment from shed seed. Nevertheless our experience of the New Zealand No. 1 under grazing is now considerable, and where plots undergoing certification trial during the last twelve months have been grazed with sheep it is outstanding.

In Table 1 the relative production of the main white clover types is set out, and in Fig. 2 the relative fall in production is graphically shown, the New Zealand No. 1 type being employed as a standard for comparison in each case.

* By Wm. Davies (on loan from Welsh Plant Breeding Station, Aberystwyth) and E. Bruce Levy.

FIG. 1. WHITE CLOVER TRIALS AT THE END OF THREE YEARS, SHOWING MARKED SUPERIORITY OF THE NEW ZEALAND NO. 1 TYPE AT THE END OF THIS PERIOD. PHOTO TAKEN 23RD SEPTEMBER, 1932.

Foreground (left to right): (*a*) Imported Dutch, entirely replaced by volunteer grass; (*b*) Kentish Wild White, showing low production and fair amount of volunteer grass; (*c*) New Zealand No. 1 type showing remarkable growth and freedom from volunteer grasses and weeds. *Mid-background* (left to right): (*a*) Ordinary New Zealand; (*b*) Imported Dutch, (*c*) Kentish Wild White; (*d*) New Zealand No. 2 plus No. 1; (*e*) New Zealand No. 1.

[*Photo by E. Bruce Levy.*

Table 1.—Relative Production of Contrasting Types of White Clover over a Three-year Growth Period.

New Zealand No. 1 type = 100 at each period.

Type.	Number of Lines averaged.	Relative Production on							
		4th Feb., 1930.	30th July, 1930.	16th Oct., 1930.	4th Dec., 1930.	23rd Jan., 1931.	10th March, 1931.	29th June, 1931.	17th May, 1932.
New Zealand No. 1 ..	37	100	100	100	100	100	100	100	100
New Zealand No. 2 ..	20	95	92	89	86	84	79	69	56
Ordinary New Zealand plus trace of No. 1 or No. 2	178	97	80	81	82	76	70	42	54
Ordinary New Zealand free from No. 1 or No. 2	344	87	51	64	55	46	35	13	17
New Zealand Dutch types	9	87	27	36	28	27	14	0·86	2·2
Kentish	15	68	55	74	64	60	52	50	28
Dutch imported ..	25	98	37	45	24	18	7·3	0·625	1·5
Ladino imported ..	2	100	75	68	30	52	50	Nil	Trace

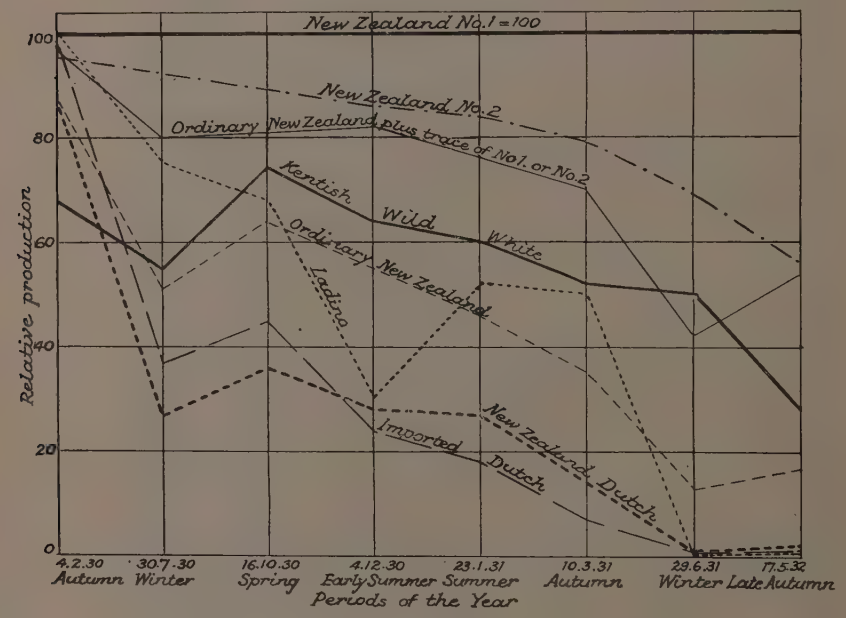


FIG. 2. GRAPH SHOWING RELATIVE PRODUCTION OF CONTRASTING TYPES OF WHITE CLOVER OVER A THREE-YEAR GROWTH PERIOD. NEW ZEALAND NO. 1 TYPE TAKEN AS STANDARD OF COMPARISON.

[*By L. W. Gorman.*

At the close of the experiments, when the photographs of Figs. 1, 3, and 4 were taken, weights were made of a number of representative plots of each clover type in these trials, and these are set out in Table 2. Estimated green weights of the proportion of white clover in the plots were taken, and as the New Zealand

No. 1 lots were all virtually pure clover this type was taken as a standard for comparison.

Table 2.—Showing Actual Green Weights of White Clover Plots (cut 27th September, 1932) and Estimated Weight of White Clover present in the Material cut. Each compared relatively with New Zealand No. 1 Type = 100.

Number of Lines.	Grade or Type.	Actual Total Green Weights in Pounds per Acre.	Compared with New Zealand No. 1 = 100.	Estimated Green Weights of Clover in Pounds per Acre.	Compared with New Zealand No. 1 = 100.
7	New Zealand No. 1 (certified mother-seed standard)	24,669	100	24,669	100
7	New Zealand No. 2 with some New Zealand No. 1 (certified permanent pasture standard)	21,615	88	21,412	87
7	New Zealand ordinary type (rejected for certification)	9,764	40	7,632	31
7	Kentish Wild White ..	10,564	43	7,551	30
6	New Zealand Dutch type	3,966	16	1,140	5
8	Imported Dutch type ..	2,929	12	1,096	4

NOTE.—Determination of green weights made on representative samples of herbage showed approximately 14 per cent. dry matter.

The trials under consideration during the last two years of their duration have been used largely to determine certification standards that will henceforth apply for white clover seed certified and sealed by the Department of Agriculture as New Zealand certified white clover (Fig. 3). It will be noted in Table 2 that certification standards have been employed as well as definite types. Lines dominantly New Zealand No. 1 type are regarded as up to mother-seed standard, and plots dominantly New Zealand No. 2 with some New Zealand No. 1 constitute the New Zealand certified permanent-pasture standard. Ordinary New Zealand white clover, while considerably better than imported Dutch types, is considered below certification standard, and therefore lines represented by this type are in the rejected class. In Table 3 is set out an analysis of 629 lines in this trial viewed from a point of view of certification. It will be noted that on the basis of this experiment, having regard to production, seasonal spread of that production, and persistency against weed and grass competition, no imported Dutch lines approached certification standard; approximately two-thirds of the Kentish Wild White lines included in the trial reached permanent-pasture standard, but no line of this type reached mother-seed standard. Possibly had these trials been conducted under rather close grazing the Kentish Wild White lots might have scored a better place, but having in view our field experience where the white clover lots have been under normal grazing, there seems little doubt that the results represent the true conditions in New Zealand at least. However, if Kentish Wild White is ever successfully harvested for seed in New Zealand this type will be included in a class apart from the certified New Zealand white clover. (See this *Journal* for May, 1932, page 315.)

FIG. 3. WHITE CLOVER TRIALS AT END OF THREE YEARS, SHOWING STANDARD SET IN REGARD TO NEW ZEALAND CERTIFIED WHITE CLOVER. PHOTO TAKEN 23RD SEPTEMBER, 1932.

Front (left): New Zealand No. 1 certificated mother-seed standard; (right) imported Dutch type, reject class. *Back* (left to right): (*a*) Part of plot only showing ordinary New Zealand white, reject class; (*b*) New Zealand No. 2 dominant, certified permanent-pasture standard; (*c*) New Zealand No. 1 dominant, certified mother-seed standard; (*d*) New Zealand ordinary, reject class.

FIG. 4. WHITE CLOVER TRIALS AT END OF THREE YEARS, SHOWING IN LEFT FOREGROUND A NEW ZEALAND NO. 1 TYPE, COMPARED WITH ORDINARY NEW ZEALAND WHITE CLOVER LOTS ON RIGHT AND IN THE BACKGROUND. PHOTO TAKEN 23RD SEPTEMBER, 1932.

[*Photos by E. Bruce Levy.*

Table 3.—Showing Classification of 629 White Clover Lines from a Point of View of Certification Standards as these now apply in New Zealand.

Dominant Type.	Number of Lines.	Mother Seed.	Permanent Pasture.	Reject.
New Zealand No. 1 ..	37	35	2	..
New Zealand No. 2 ..	20	9	10	1
Ordinary New Zealand plus some type No. 1 or No. 2	181	47	80	54
Ordinary New Zealand ..	340	..	..	340
New Zealand Dutch ..	9	..	..	9
Imported Dutch	25	..	..	25
Ladino	2	..	..	2
Kentish	15	..	10	5
Totals	629	91	102	436

The superiority of the New Zealand certified white clover undoubtedly is due to the No. 1 strain that it contains, and we feel that the marked success and good name which New Zealand white clover enjoys overseas is due largely to the presence in lines shipped of a proportion at least of the New Zealand No. 1 or No. 2 types. In our plot work, lines that three years ago contained but a trace of New Zealand No. 1 were dominantly this type of white at the end of the third year, the poorer lower-growing types being swamped out by the more aggressive New Zealand No. 1. This is reflected in Table 3, where out of 181 lines that were dominantly ordinary New Zealand type at the commencement of the test, but which contained a trace or some No. 1 and No. 2, forty-seven lines reached mother-seed standard and eighty attained permanent-pasture standard under the conditions of this trial. Table 4 shows this point fairly well. It will be noted that the lines of type 3 (ordinary New Zealand), plus a trace of type 1, have maintained their superiority, approaching in this respect type 1 itself at the end of the three years, whereas lines of type 3 having no trace of type 1 in them have fallen very low by the end of the third year. Fig. 5 illustrates the same point graphically.

Table 4.—Showing Superiority of New Zealand No. 1 at each Date, and also how even a Trace of New Zealand No. 1 in an ordinary New Zealand (Type 3) Line raises its Production.

Type.	Number of Lines.	4th Feb., 1930.	30th July, 1930.	16th Oct., 1930.	4th Dec., 1930.	23rd Jan., 1931.	10th Mar., 1931.	29th June, 1931.	17th May, 1932.
New Zealand type 1 ..	37	100	100	100	100	100	100	100	100
Ordinary New Zealand (type 3) plus trace of type 1	59	100	86	90	93	91	93	83	91
New Zealand type 2 ..	20	95	92	89	86	84	79	69	56
Ordinary New Zealand plus trace of type 2	119	95	75	78	77	68	58	22	36
Ordinary New Zealand ..	344	87	51	64	55	46	35	13	17

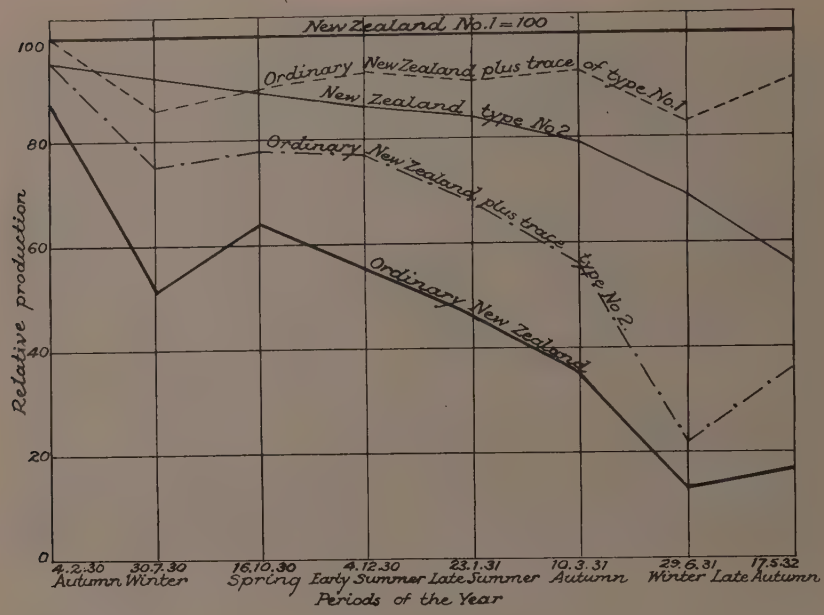


FIG. 5. GRAPH SHOWING PRODUCTION OF THE MAJOR NEW ZEALAND LOTS OF WHITE CLOVER, AND HOW A TRACE OF NEW ZEALAND NO. 1 TYPE IN A LINE WILL UNDER NORMAL CONDITIONS RAISE THE PERSISTENCY AND PRODUCTION OF THAT LINE.

[By L. W. Gorman.

In our plot work the plots were divided laterally by a 1-ft. division which was kept cultivated, but the layout of the plots was such that two plots adjoined one another back to back, and this junction was not cultivated as in the lateral divisions. In every case in the three years there has been a spread of from 2 ft. to 4 ft. of the New Zealand No. 1 type into the adjoining type backing on to it. Even moderately good lots of white clover have been subdued by the more vigorous No. 1 type. At one stage the cultivation of the lateral divisions was delayed somewhat, and a few stolons of a New Zealand No. 1 type crossed over into a Kentish Wild White plot alongside. Fig. 6 shows the Kentish Wild White six months later being smothered out by the rapid spread of the higher-producing New Zealand No. 1.

The trials under review perhaps as much as anything else have pressed home very forcibly the value of persistency, coupled with high production in a strain. In the case of the New Zealand No. 1 white clover, at the end of three years these plots were 100 per cent. clover, and at no stage did they contain weed and volunteer grass growth (Fig. 7). Low persistency in a strain means death of that species and a corresponding opening-up of the sward leading to weed and volunteer grass invasion. Low production, particularly low winter and low early spring production, means swamping out of such a type by winter-growing grasses and weeds. The inability of the Kentish Wild White lines to dominate their respective plots was due to the factor of low production rather than to low persistency.

FIG. 6. SHOWING COMPETITIVE GROWTH VALUES OF NEW ZEALAND NO. 1 TYPE AND KENTISH WILD WHITE.

The New Zealand No. 1 type is seen on the right; the Kentish Wild White plot on the left is being invaded in the third year by a stolon of New Zealand No. 1 that spread from the parent plot on the right. The taller-growing, higher-producing New Zealand type is smothering the Kentish Wild White at point of invasion.

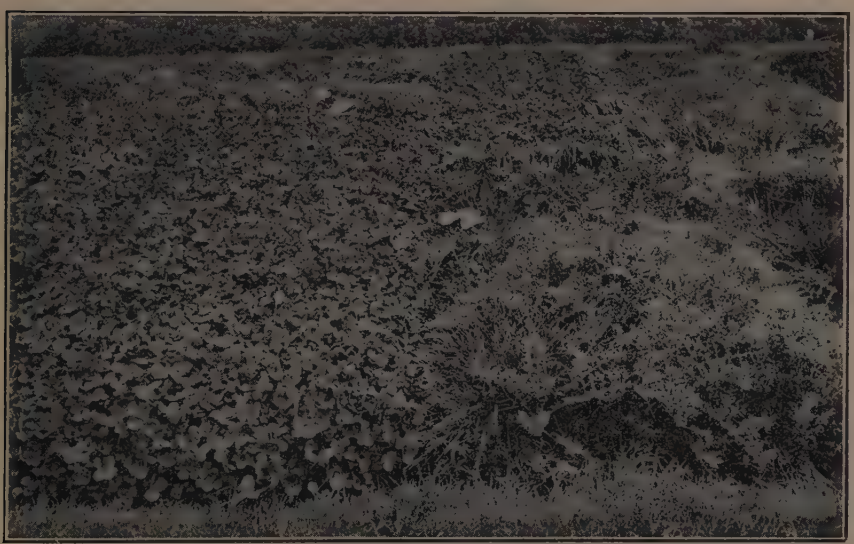


FIG. 7. NEW ZEALAND NO 1 WHITE CLOVER AND A NEW ZEALAND DUTCH LINE, COMPARED AT THE END OF THE SECOND YEAR OF THE TRIAL. PHOTO TAKEN 1ST NOVEMBER, 1931.

The New Zealand No. 1 (left) is free of weeds, indicating value of persistency in a type as regards weed control. Weeds and volunteer grasses have taken up the running as the non-persistent New Zealand Dutch white clover type on the right died out.

[*Photos by E. Bruce Levy.*

The aim in permanent-pasture establishment is to obtain and maintain a sward of the species sown. Rapid changes in the pasture association—apart from seasonal fluctuations in the growth of the pasture components—are a hazard to success, because in the course of these changes an opportunity is afforded for weeds and inferior grasses to lay hold of the ground. Every endeavour should be made to introduce strains at sowing-time that are capable of holding the ground, and there seems little doubt that the certification of tested pasture strains will play an enormous part in the accomplishing of this. Of the white clovers of the world, for New Zealand conditions at least, the New Zealand certified white clover provides the most reliable material obtainable on world markets to-day.

A point in this experiment that should be stressed is the initial layout of the trial. Seedings of each lot were made in double rows 2 ft. apart, and the space between the rows was kept intercultivated until the white clover occupied this space by lateral spread from the original rows established as a result of seeding. By this means the appearance of volunteer white clover was almost entirely prevented, and the identity of each lot sown retained throughout the experiment.

Single-plant Trials.

In the single-plant trials there can be no question of suppression or replacement as a result of weed or grass competition. These single plants were intertilled and weeded, and were trimmed back periodically with the spade, the crown of the original plant in each case being preserved. Table 5 shows the percentage of single plants of each type persisting at various dates during the single-plant trial.

Table 5.—Percentage of Single Plants of each Type persisting at various Dates during the Spaced Plant Trial.

Type.	Percentage persisting at the Stated Dates.			
	7/12/30, 1 yr. 2 mo. after Planting out.	4/3/31, 1 yr. 5 mo. under Trial.	25/6/31, 1 yr. 8 mo. under Trial.	10/12/31, 2 yr. 2 mo. under Trial.
New Zealand No. 1	100	100	100	99·4
New Zealand No. 2	100	100	98	83
Ordinary New Zealand ..	100	99	87	46
New Zealand Dutch ..	92	85	58	16
Kentish Wild White ..	99	99	96	70
Imported (other than Kentish)	96	86	62	20

Notes on the relative growth made by each type over the two-year period of the single-plant trial were made, and results are set out in Table 6. The New Zealand No. 1 type was outstanding, and is taken as a standard of comparison at each respective date. Fig. 8 shows graphically the relative growth made by each type throughout this trial.

Table 6.—Relative Growth as Single Plants.

New Zealand No. 1 = 100 at each recording period.

Type.	Relative Growth at the Stated Periods.								
	28/2/30, Summer.	28/3/30, Autumn.	25/6/30, Winter.	5/10/30, Spring.	7/12/30, Summer.	25/1/31, Late Summer.	4/3/31, Autumn.	25/6/31, Winter.	10/12/31, Summer.
New Zealand No. 1 ..	100	100	100	100	100	100	100	100	100
New Zealand No. 2 ..	91	93	69	53	78	72	65	32	36
Ordinary New Zealand ..	80	80	41	21	40	32	23	6	5
New Zealand Dutch ..	74	58	18	5	10	9	5	¼	½
Kentish Wild White ..	76	76	38	29	55	45	37	9	16
Imported—average types..	76	80	33	18	30	21	15	3	4
Imported—poor forms ..	66	55	15	5	6	4	2	Trace	½

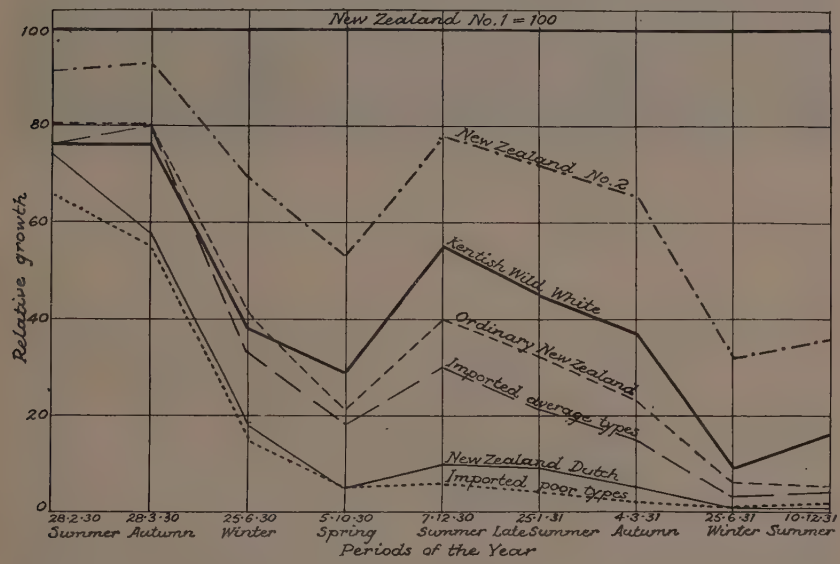


FIG. 8. GRAPH SHOWING RELATIVE GROWTH OF EACH WHITE CLOVER TYPE AS SINGLE PLANTS OVER A TWO-YEAR TRIAL.

[*By L. W. Gorman.*

Value of White Clover in a Pasture.

It is almost impossible to place a value on what white clover means to the pastoral industry of New Zealand. Pride of place rests between white clover and perennial rye-grass. Viewing the pastures as they exist to-day, and considering the fact of so much rye-grass of poor type having been sown, we have no hesitation in saying that white clover is contributing year in and year out the greater proportion of the food of the pasture. While this state probably should not exist in the ideally constituted pasture, yet the fact that this is so over a very wide area to-day cannot be gainsaid.

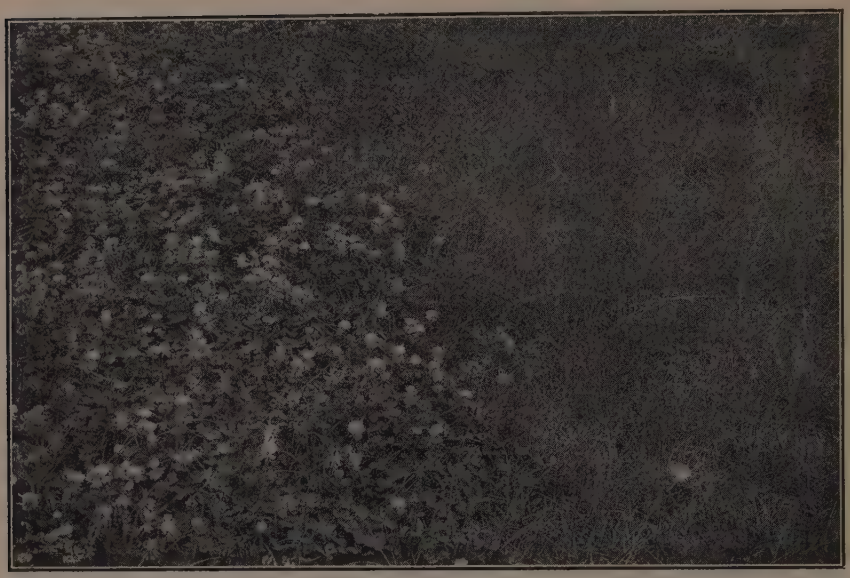


FIG. 9. SHOWING VALUE OF WHITE CLOVER AS A PASTURE-COMPONENT DURING LATE SPRING AND EARLY SUMMER.

On right is a pure rye-grass stand; on left a white clover and rye-grass association. The rye-grass - white clover plots yielded on the average four times as much as the pure rye-grass plots at time photo taken, 2nd February, 1932. (See Table 7.)

[Photo by E. Bruce Levy.

The substitution of the present white-clover type by a still higher-producing type—the New Zealand certified type—and associating this with a good certified rye-grass type, together with the balancing of these by suitable manuring, seems basic to a big forward grassland-improvement movement.

The place that white clover occupies as a pasture species, during the summer months particularly, may be illustrated by weighings of plots made in the course of the plot strains testing work at the Plant Research Station (Fig. 9). In Table 7 are given results of weighings done on 18th January, 1932, on comparatively light soil. The rye-grass lots were pure sowings of the certified type, and the plots were nine months old. In the case of the rye-grass and white clover combination the plots had been sown one year previously, and as a result of close and continuous mowing the rye-grass had weakened considerably, and had allowed a great deal of volunteer white clover to come in. Dry weather also, which is usual in January–March, was not favourable to rye-grass growth, but the white clover was growing well at this period.

It may be argued that a still higher-producing white clover than exists at the present on the average farm is not required by the farmer. His complaint is largely one of too much clover—meaning too much white clover, during the late spring and early summer particularly. A higher-producing clover and one with a longer

Table 7.—Comparison of Yield between Rye-grass alone Plot and Rye-grass-White Clover Plots adjoining.

Green weights taken on 18th January, 1932.

Set of Weighings.	Rye-grass alone, in Pounds per Acre.	Rye-grass-White Clover: Plots adjoining respectively, in Pounds per Acre.
1	5,094	18,844
2	1,875	12,875
3	2,500	9,781
4	2,720	12,844
5	2,875	9,687
Average ..	3,013	12,806

seasonal growth, such as is possessed by the New Zealand No. 1 type, will undoubtedly bring with it greater demands on the part of the farmer for its efficient utilization, and in the balancing-up of the grass to clover content of the pasture by more specific manuring. The plant selector and breeder can aim at increased production, longevity, long seasonal spread of productivity, wide adaptability range, high feeding-qualities, freedom from disease, &c. He expects that when a good thing is discovered or bred any special call on the part of management and utilization will be met by the farmer.

High-producing Species or Strains of these in Relation to Soil Quality.

A word of warning is necessary against undue optimism on the part of the farmer in the use on low-yielding soils of high-producing strains represented by the New Zealand No. 1 white clover. A high producer, be it an animal or plant, must be adequately fed. The aggressive nature and high-producing qualities of the New Zealand No. 1 strain can assert themselves only when the plant is well nourished. If dwarfed and stunted through being ill-nourished, then it does not cover the ground completely, and room is afforded volunteer annual types of white clover—purely annual clovers such as suckling clover, &c.—to still persist; and these species, being ecologically more perfectly adapted for the drier, poorer, and harder habitats, may actually do better than the New Zealand No. 1 white clover when the latter is sown on soil that does not meet its fertility requirement. This warning is particularly applicable to growers who may contemplate launching out on a fairly large scale in the once-growing of New Zealand No. 1 type under certification. The possibilities in successfully growing this type for seed under certification are very great, but we would advise farmers, for a start at least, to keep to medium-quality soil-types or those that will respond to manurial treatment, until such time as it is more conclusively shown that the habitat range of this clover can be extended for seed production and grazing on to the drier and less fertile soils of both the North and the South Island. On high-fertility soil-types seed production may call for special sward management and manipulation of crop, owing to the continuous and heavy leaf-growth of this clover on such soils.

POTATO MANURING EXPERIMENTS IN THE SOUTH ISLAND, SEASON 1931-32.

FIELDS DIVISION, Department of Agriculture.

EIGHT experiments on the manuring of potatoes were conducted by the Fields Division in the South Island during the season 1931–32. The results of sixty-seven experiments carried out prior to the 1931–32 season were outlined in the *Journal* for January, 1932. As the use of superphosphate with the potato crop had been fairly well investigated in these sixty-seven trials, and as it had been shown that the use of super at 3 cwt. per acre was in nearly all cases highly profitable, it was decided in the season now under review to further investigate the possibilities of potash or nitrogen, both of which in previous seasons had given diverse results chiefly depending on soil and weather conditions. In four of the experiments, however, no-manure plots were included, and in one trial superphosphate at 5 cwt. per acre was included as well as super at 3 cwt.

TYPE OF EXPERIMENTS.

Three types of experiment were carried out, although in one or two cases slight modifications, as indicated below, were introduced. Type A is a continuation of the previous season's programme, and this type of experiment has been carried out during the past five seasons. Types B and C are innovations, and the purpose for which each was designed is indicated under the details of treatments which are enumerated below.

Type A.—To determine the effect of superphosphate on yield and of sulphate of ammonia and sulphate of potash as adjuncts to super. Treatments per acre :—

(1) No manure.
(2) Superphosphate (44/46 per cent. tricalcic phosphate) 3 cwt.
(3) Super 3 cwt. plus sulphate of ammonia 1 cwt.
(4) Super 3 cwt. plus sulphate of ammonia 1 cwt. plus sulphate of potash 1 cwt.
(5) Super 3 cwt. plus sulphate of potash 1 cwt.

Four of these experiments were laid down. It was intended to use Type A experiments on land where potash had not been previously tried or in districts in which potash effect, as indicated by previous experiments, had been doubtful.

Type B.—To determine the effect of varying the quantities of sulphate of ammonia and/or sulphate of potash. Treatments per acre :—

(1) Superphosphate (44/46 per cent.) 3 cwt.*
(2) Super 3 cwt. plus sulphate of potash 1 cwt.
(3) Super 3 cwt. plus sulphate of potash 1 cwt. plus sulphate of ammonia 1 cwt.
(4) Super 3 cwt. plus sulphate of potash 2 cwt. plus sulphate of ammonia 1 cwt.
(5) Super 3 cwt. plus sulphate of potash 2 cwt. plus sulphate of ammonia 2 cwt.
(6) Super 3 cwt. plus sulphate of potash 1 cwt. plus sulphate of ammonia 2 cwt.

* Super 5 cwt. was used in all treatments on rich potato soils.

Three experiments of this type were carried out, and such trials were to have been laid down on soils which had in the past been definitely responsive to potash. In one trial on which this type of experiment was carried out there was no evidence to show that potash had been effective. In one trial (No. 7) treatments 1 and 2 were omitted, as these were included in a Type A experiment on the same field.

Type C.—To determine the effect of increasing the quantities of super from 3 cwt. to 5 cwt. and the amount of sulphate of ammonia from 1 cwt. to 2 cwt. Treatments per acre :—

(1) Super (44/46 per cent.) 3 cwt.
(2) Super 5 cwt.
(3) Super 5 cwt. plus sulphate of ammonia 1 cwt.
(4) Super 5 cwt. plus sulphate of ammonia 1 cwt. plus sulphate of potash 1 cwt.
(5) Super 5 cwt. plus sulphate of ammonia 2 cwt.

Only one of these experiments was conducted. This type was designed for rich soils where potash had been shown previously not to be effective on yield.

It was not possible in all cases to lay down experiments on the desired soils of previously known performance as indicated above, but as far as facilities permitted this was done.

Other Particulars.

Size of Plot and Number of Replications.—Apart from one trial where three-row plots were used, trials were laid down having single-row plots by 2 chains in length. Twenty or twenty-one replications of treatments were included in each experiment, except one in which only ten replications were sown. The method of conducting potato-manuring experiments was described in the *Journal* for July, 1926, and except that hand application of fertilizers in the row and single-row plots is now adopted the procedure is much the same.

Interpretation of Results. — Results were examined statistically, using "Student's" method. Differences are stated to be either "significant," in which case they may be accepted with confidence, or "not significant." In the latter case differences may in reality be due to the treatments applied, but they cannot be accepted with any degree of confidence.

Economic Aspect of Results.—It is not intended to discuss at this stage the economic aspect of the results, particularly since some of the treatments—namely, those including 2 cwt. of sulphate of ammonia or sulphate of potash—have been under trial for only one season. It is considered more advisable to summarize the effects of these after experiments have been conducted over a period of several seasons, especially since the 1931–32 season was abnormally dry during the greater part of the period of growth of the potato crop.

Results of Type A Experiments.

(1) Co-operating farmer : C. Redmond, Kimberley.

Variety : Aucklander Short Top. Date planted : 29/10/31. Previous crop : Grass. Crop dug and weighed : 15/6/32.

Table 1.—Results of C. Redmond's Experiment.

Treatment, per Acre.	Yield, in Tons per Acre.		
	Table.	Seed.	Total.
(1) No manure	1·6	3·2	4·8
(2) Super 3 cwt.	1·4	4·2	5·6
(3) Super 3 cwt. plus sulphate of ammonia 1 cwt. ..	1·6	5·1	6·7
(4) Super 3 cwt. plus sulphate of ammonia 1 cwt. plus sulphate of potash 1 cwt.	1·6	4·4	6·0
(5) Super 3 cwt. plus sulphate of potash 1 cwt. ..	1·6	4·8	6·4

Remarks on yield: No significant differences between treatments were recorded in table-grade potatoes, but in seed and total potatoes super 3 cwt. was significantly better than no manure. Super plus sulphate of ammonia and super plus sulphate of potash were both significantly better than super and super plus sulphate of ammonia plus sulphate of potash.

General comments: Extremely dry conditions were experienced through the growing season until February. It was noticeable that the super and super plus sulphate of ammonia plots had ripened off more rapidly than the other treatments, while no manure and super plus sulphate of potash both had the greenest and most upright shaws. It is probable that the first-mentioned treatments, on which the shaws had died off, were not able to benefit from the February rain.

(2) W. A. MCPHAIL, JUN., MITCHAM.

Variety: Dakota. Date planted: 2/11/31. Previous crop: Grass, four years. Crop dug and weighed: 10/6/32.

Table 2.—Results of W. A. McPhail's Experiment.

Treatment, per Acre.	Yield, in Tons per Acre.			
	Table.	Seed.	Small.	Total.
(1) No manure	3·0	1·1	0·5	4·6
(2) Super 3 cwt.	3·8	1·6	0·8	6·2
(3) Super 3 cwt. plus sulphate of ammonia 1 cwt.	4·2	1·7	1·1	7·0
(4) Super 3 cwt. plus sulphate of ammonia 1 cwt. plus sulphate of potash 1 cwt.	4·4	1·7	1·0	7·1
(5) Super 3 cwt. plus sulphate of potash 1 cwt...	3·9	1·5	0·8	6·2

Remarks on yield: Super was significantly better than no manure in all grades. Super plus sulphate of ammonia was significantly better than super in table, small, and total potatoes, but super plus sulphate of potash was not significantly different from super. The yield of super plus sulphate of ammonia plus sulphate of potash was significantly higher than that of super plus sulphate of potash in table, small, and total potatoes, but was not significantly different from super plus sulphate of ammonia.

(3) EXPERIMENTAL AREA, GORE.

Variety: King Edward. Date planted: 23/9/31. Previous crops: 1929, lupins; 1929–30, swedes; 1930–31, lupins (ploughed in). Crop dug and weighed: 14/4/32.

Table 3.—Results at Gore Experimental Area.

Treatment, per Acre.	Yield, in Tons per Acre.			
	Table.	Seed.	Small.	Total.
(1) No manure	3·2	3·0	3·1	9·3
(2) Super 3 cwt.	3·6	3·4	4·4	11·4
(3) Super 3 cwt. plus sulphate of ammonia 1 cwt.	3·7	3·7	5·2	12·6
(4) Super 3 cwt. plus sulphate of ammonia 1 cwt. plus sulphate of potash 1 cwt.	4·0	3·9	5·1	13·0
(5) Super 3 cwt. plus sulphate of potash 1 cwt...	4·0	3·5	4·4	11·9

Remarks on yield: Super was significantly better than no manure in all grades. Super plus sulphate of potash was significantly better than super in table and total potatoes. Super plus sulphate of ammonia was significantly better than super in seed, small, and total. The differences between super plus sulphate of ammonia and super plus sulphate of ammonia plus sulphate of potash, although not statistically significant, are probably real. The latter was significantly better than super plus sulphate of potash in yields of seed, small, and total potatoes (see remarks following Table 7).

(4) S. KOKAY, TUATAPERE.

Variety: King Edward. Date planted: 27/10/31. Previous crops: 1929–30, swedes (after stumping); 1930–31, potatoes. Crop dug and weighed: 23/5/32.

Table 4.—Results of S. Kokay's Experiment.

Treatment, per Acre.	Yield, in Tons per Acre.			
	Table.	Seed.	Small.	Total.
(1) No manure	4·2	5·4	2·0	11·6
(2) Super 3 cwt.	6·4	6·5	2·9	15·8
(3) Super 3 cwt. plus sulphate of ammonia 1 cwt.	6·7	6·9	3·1	16·7
(4) Super 3 cwt. plus sulphate of ammonia 1 cwt. plus sulphate of potash 1 cwt.	6·9	7·7	3·1	17·7
(5) Super 3 cwt. plus sulphate of potash 1 cwt.	6·0	6·8	2·8	15·6

Remarks on yield: In this experiment the increases due to super are outstanding and in all grades differences are significant. Super plus sulphate of potash has given a significant depression in yield below that of super in table potatoes, but differences in seed, small, and total are not significant. Super plus sulphate of ammonia is significantly better than super in total yield only. Super plus sulphate of ammonia plus sulphate of potash is significantly better than super plus potash in table, seed, and total potatoes, and better than super plus sulphate of ammonia in seed and total.

Results of Type B Experiments.

(5) HIGH SCHOOL, RANGIORA.

Variety: Aucklander Short Top. Date planted: 1/11/31. Previous crops: 1930–31, oats; 1931–32, barley. Crop dug and weighed: 21/6/32.

Table 5.—Results at Rangiora High School.

Treatment, per Acre.	Yield, in Tons per Acre.		
	Table.	Seed.	Total.
(1) Super 3 cwt.	1·1	1·6	2·7
(2) Super 3 cwt. plus sulphate of potash 1 cwt. ..	1·1	1·8	2·9
(3) Super 3 cwt. plus sulphate of potash 1 cwt. plus sulphate of ammonia 1 cwt.	1·1	1·9	3·0
(4) Super 3 cwt. plus sulphate of potash 2 cwt. plus sulphate of ammonia 1 cwt.	1·1	1·9	3·0
(5) Super 3 cwt. plus sulphate of potash 2 cwt. plus sulphate of ammonia 2 cwt.	1·2	2·0	3·2
(6) Super 3 cwt. plus sulphate of potash 1 cwt. plus sulphate of ammonia 2 cwt.	1·2	1·7	2·9

Remarks on yield: The crop suffered severely from the very dry season. Very few table-grade potatoes were present, and, at digging, the fertilizers turned out in much the same condition as when they went in. Potato crops generally in this district were only fair in the 1931–32 season. Treatment 5 (super 3 cwt. plus sulphate of potash 2 cwt. plus sulphate of ammonia 2 cwt.) was significantly better than treatment 6 (super 3 cwt. plus sulphate of potash 1 cwt. plus sulphate of ammonia 2 cwt.) in the seed grade. This was the only significant difference.

(6) C. A. TESCHNER, GORE.

Variety: Arran Chief. Date planted: 21/10/31. Previous crop: Grass (several years). Crop dug and weighed: 4/6/32.

Table 6.—Results of C. A. Teschner's Experiment.

Treatment, per Acre.*	Yield, in Tons per Acre.			
	Table.	Seed.	Small.	Total.
(1) Super 5 cwt.	5·9	4·2	2·1	12·2
(2) Super 5 cwt. plus sulphate of potash 1 cwt.	6·1	4·3	2·0	12·4
(3) Super 5 cwt. plus sulphate of potash 1 cwt. plus sulphate of ammonia 1 cwt.	6·7	4·7	2·2	13·6
(4) Super 5 cwt. plus sulphate of potash 2 cwt. plus sulphate of ammonia 1 cwt.	7·1	4·6	2·2	13·9
(5) Super 5 cwt. plus sulphate of potash 2 cwt. plus sulphate of ammonia 2 cwt.	8·0	4·6	2·0	14·6
(6) Super 5 cwt. plus sulphate of potash 1 cwt. plus sulphate of ammonia 2 cwt.	7·7	4·7	2·2	14·6

* As this experiment was on better-class potato land, super 5 cwt. was used instead of 3 cwt. per acre.

Remarks on yield: Larger-sized potatoes than are usually kept for seed were included in the seed grade in this experiment, and probably one-third of the weight of the latter would normally be table.

The yield of treatment 3 (super 5 cwt. plus sulphate of potash 1 cwt. plus sulphate of ammonia 1 cwt.) was significantly better than that of treatment 2 (super 5 cwt. plus sulphate of potash 1 cwt.) in all grades. Treatment 6 (super 5 cwt. plus sulphate of potash 1 cwt. plus sulphate of ammonia 2 cwt.) was significantly better than treatment 3 (super 5 cwt. plus sulphate of potash 1 cwt. plus sulphate of ammonia 1 cwt.) in table and total potatoes. Treatment 5 (super 5 cwt. plus sulphate of potash 2 cwt. plus sulphate of ammonia 2 cwt.) was significantly better than treatment 4 (super 5 cwt. plus sulphate of potash 2 cwt. plus sulphate of ammonia 1 cwt.) in table and total potatoes. There were no other significant differences, so that in this experiment, while both 1 cwt. and 2 cwt. of sulphate of ammonia have been effective on yield, sulphate of potash has not given any significant increases, although small but consistent increases in table potatoes with increased quantities of potash suggest that its effect is definite.

(7) EXPERIMENTAL AREA, GORE.

Variety: King Edward. Date planted: 24/9/31. Previous crops: See Experiment 3. Crop dug and weighed: 14/4/32.

Table 7.—Results at Gore Experimental Area.

Treatment, per Acre.*	Yield, in Tons per Acre.			
	Table.	Seed.	Small.	Total.
(3) Super 3 cwt. plus sulphate of potash 1 cwt. plus sulphate of ammonia 1 cwt.	4·1	3·9	5·1	13·1
(4) Super 3 cwt. plus sulphate of potash 2 cwt. plus sulphate of ammonia 1 cwt.	4·6	4·2	5·3	14·1
(5) Super 3 cwt. plus sulphate of potash 2 cwt. plus sulphate of ammonia 2 cwt.	4·8	4·2	5·2	14·2
(6) Super 3 cwt. plus sulphate of potash 1 cwt. plus sulphate of ammonia 2 cwt.	4·3	4·0	5·3	13·6

* Treatments 1 and 2 were not sown in this experiment, as they were included in Experiment 3 which was on the same field.

Remarks on yield: Treatment 6 (super 3 cwt. plus sulphate of potash 1 cwt. plus sulphate of ammonia 2 cwt.) was significantly better than treatment 3 (super 3 cwt. plus sulphate of potash 1 cwt. plus sulphate of ammonia 1 cwt.) in total potatoes only. The yield of treatment 4 (super 3 cwt. plus sulphate of potash 2 cwt. plus sulphate of ammonia 1 cwt.) was significantly greater than that of treatment 3 (super 3 cwt. plus sulphate of potash 1 cwt. plus sulphate of ammonia 1 cwt.) in table, seed, and total potatoes. Treatment 5 (super 3 cwt. plus sulphate of potash 2 cwt. plus sulphate of ammonia 2 cwt.) was significantly better in yield than treatment 6 (super 3 cwt. plus sulphate of potash 1 cwt. plus sulphate of ammonia 2 cwt.) in table and total potatoes, but the former was not significantly different from treatment 4 (super 3 cwt. plus sulphate of potash 2 cwt. plus sulphate of ammonia 1 cwt.).

Results of Type C Experiments.

(8) H. D. NORMAN, TUATAPERE.

Variety: Up-to-date. Date planted: 28/10/31. Previous crops: 1928–29, swedes; 1929–30, oats; 1930–31, grass. Crop dug and weighed: 21/5/32.

Table 8.—Results on H. D. Norman's Farm.

Treatment, per Acre.	Yield, in Tons per Acre.		
	Table.	Seed.	Total.
(1) Super 3 cwt.	12·1	7·0	19·1
(2) Super 5 cwt.	13·7	7·2	20·9
(3) Super 5 cwt. plus sulphate of ammonia 1 cwt. ..	14·7	7·8	22·5
(4) Super 5 cwt. plus sulphate of ammonia 1 cwt. plus sulphate of potash 1 cwt.	13·7	7·9	21·6
(5) Super 5 cwt. plus sulphate of ammonia 2 cwt. ..	14·9	8·4	23·3

Remarks on yield: The crop was badly attacked by late blight, and quite 50 per cent. of the tubers were affected. None of the treatments had any effect on the incidence of blight. The yield of super 5 cwt. shows a significant and very appreciable increase over that of super 3 cwt. Super 5 cwt. plus sulphate of ammonia 1 cwt. is significantly better than super 5 cwt. in total potatoes, and is significantly better than super 5 cwt. plus sulphate of ammonia 1 cwt. plus sulphate of potash 1 cwt. in table grade. Super 5 cwt. plus sulphate of ammonia 2 cwt. is significantly better than super 5 cwt. plus sulphate of ammonia 1 cwt. in seed grade only.

Summary.

The results of eight experiments on the manuring of potatoes conducted in the South Island during the 1931–32 season are given. The outstanding features are as follows:—

The average increase in yield due to super 3 cwt. per acre was, in four experiments, 16 cwt. of table and 15 cwt. of seed potatoes.

The average increase due to the use of super 3 cwt. in forty-eight experiments conducted since 1925–26, including the above, is 19 cwt. table and 6 cwt. seed potatoes.

In one trial where super 5 cwt. was compared with super 3 cwt. there was an increase in favour of the larger quantity by 1·6 tons table and 4 cwt. seed. This trial was on better-class potato soil.

The use of sulphate of ammonia at 1 cwt. per acre as an addition to super in five trials shows a general average increase over super alone of about 8 cwt. table, 9 cwt. seed, and 22 cwt. total potatoes. When used with super plus potash the effect of sulphate of ammonia is slightly less.

In forty-one trials conducted since 1925–26 the average increase due to the addition of 1 cwt. of sulphate of ammonia to super has been 10 cwt. table, 6 cwt. seed, and 18 cwt. total potatoes. The average increase when 1 cwt. sulphate of ammonia has been added to super plus potash in forty-two experiments conducted to date has been 9 cwt. table, 4 cwt. seed, and 17 cwt. total potatoes.

The relatively large increases in seed and small-grade potatoes resulting from the use of sulphate of ammonia in the 1931–32 season is no doubt largely due to the extremely dry conditions experienced during the growing season.

Sulphate of potash was effective at one centre (Experiments 3 and 7, Gore Experimental Area), although in another trial at Gore (No. 6), while there were no significant increases, small but consistent increases in table potatoes with increased quantities of sulphate of potash suggested that its effect was definite.

In Experiment No. 1 (Kimberley) both sulphate of potash and sulphate of ammonia added to super had the effect of increasing yield to a significant extent. However, the combined addition of these to super, giving a complete mixture, resulted in a lower yield than either super plus sulphate of ammonia or super plus sulphate of potash.

On the other hand, in Experiment No. 4 (Tuatapere), sulphate of potash added to super caused a significant depression in yield of table potatoes, but when sulphate of potash was used as an addition to super plus sulphate of ammonia the yield was increased above that of super plus sulphate of ammonia or super plus sulphate of potash.

Somewhat similar results were referred to in the *Journal* for January, 1932, pp. 54 and 55, when it was recorded as having occurred in previous experiments.

The thanks of the Department are extended to those farmers who provided land and facilities for carrying out the experiments. The field work in connection with the trials was carried out under the direction of Mr. R. McGillivray, Fields Superintendent, Christchurch, and Mr. R. B. Tennent, Fields Superintendent, Dunedin, by the following officers in their respective districts: G. G. Calder, Instructor in Agriculture, Christchurch; E. M. Bates, Instructor in Agriculture, Ashburton; A. A. Hume, Instructor in Agriculture, Invercargill; W. Faithful, Fields Instructor, Gore; J. Sleeman, Overseer, Gore Experimental Area.

—*A. W. Hudson, Crop Experimentalist, and J. W. Woodcock, Assistant Crop Experimentalist.*

Grassland Research at Welsh Plant Breeding Station, Aberystwyth.— In the Grassland section of his "Conspectus of Recent Agricultural Research" Lord Bledisloe pays a tribute to the high economic value of Professor Stapledon's work throughout the Empire, and adds: "One interesting feature of it is the choice of herbage plants on the basis not only of their nutritive value and local suitability, but also of their attractiveness to live-stock, as judged by their selective feeding on adjoining patches of distinct varieties. His most valuable recent development is the improvement of the grazing on the open Welsh hills. The Caterpillar tractor is employed, and the minimum of scratching is given with appropriate implements. Wild white and red clover cleanings are sown, supported by poor grasses like Yorkshire fog and sweet-scented vernal, and small dressings of manure are applied. The extraordinary pasture improvement which is resulting opens up all manner of hopeful possibilities in regard to the carrying capacity of poor hill land."

CITRUS-FRUIT SPECIES AND VARIETIES IN NEW ZEALAND.

Substance of a radio lecturette by P. EVERETT, Orchard Instructor, Horticulture Division, Gisborne.

THE term "citrus fruit" embraces all fruits with a rind similar to that of an orange or lemon, and trees of this family are almost all evergreen. While citrus varieties can be and are being grown in many parts of New Zealand adjacent to the sea-coast, they thrive best in the eastern coastal areas of the Auckland Province, including Gisborne. Any kind or variety of citrus, once the tree has become well established, will not suffer any great injury when exposed to about four or five degrees (Fahr.) of frost, although this temperature may destroy the tips of tender growth, thus checking the progress of the tree. Generally speaking, it is not advisable to plant lemons where frost is likely to exceed four or five degrees.

Using general terms, the citrus family is divided into nine classes or kinds. These are the orange, lemon, mandarin, pomelo or grape-fruit, lime, citron, shaddock, kumquat, and limequat. There are varieties of both bitter and sweet oranges; lemons all have an acid flavour; mandarins are all sweet, although some varieties are much sweeter than others. There are also varieties of both sweet and acid limes and shaddocks, the acid flavour being the more common. The pomelo, which is more commonly known as grape-fruit, varies in flavour very much according to variety, but taking the class as a whole it might be described as a bitter-sweet flavour. The flavour of all citrons and the limequat is acid, whereas the kumquat has a flavour peculiarly its own.

Although citrus trees are not exacting as to soil requirements, they give best results when grown in deep, rich, porous, well-drained soil, and trees in this class of soil are usually long-lived. Heavy clay or swampy soils should be avoided; also soils that have a hard pan or impervious clay subsoil are equally unsuitable. Good drainage of both surface and subsoil is essential to success. In planting citrus trees it is also of great importance to select a locality that is protected from strong wind, more especially the southerly and westerly winds. While citrus *can* be grown when exposed to all winds they will *never* give satisfactory results unless reasonably well sheltered.

ORANGES.

There are more than twenty different varieties of oranges growing in New Zealand, which include the leading commercial varieties grown in California, Australia, and other orange-growing countries. Most of these varieties grow readily in suitable localities and bear heavy crops of fruit. While oranges can be and are being grown in warm, sheltered localities in many parts of the South Island, they give much better results when grown in the more northern districts.

Many of the oldest orange-trees in New Zealand were raised from seed, and as a consequence the type of fruit produced is very

inferior. The distribution of fruit from these seedling orange-trees has given many people the impression that good-flavoured and juicy oranges cannot be grown in this country. This impression is quite wrong, for fruit produced by certain modern varieties is extremely palatable and full of juice. While this fruit may not reach the height of perfection, it is sweet and juicy, and worthy of a place in every suitable home orchard.

Many acres of sweet oranges are now grown for commercial purposes in New Zealand, and the public demand for this fruit is rapidly improving with the advent of varieties suitable to our climatic conditions. A variety very suitable for planting in home orchards is the Ruby Blood. For sweetness and flavour this variety is one of the best for our climate. The Valencia Late is another good variety worthy of planting. Though it is not so sweet as the Ruby Blood it has the advantage of ripening late in the season, when the weather is warmer and the desire for orange-juice is much greater. A further good mid-season variety is Best's Seedless, which is a very vigorous grower and has a nice flavour. While there are many other very good varieties, some of which have not yet been thoroughly tried in New Zealand, the three which have been named will make a nice collection for a home orchard.

The two principal varieties of bitter orange grown are Seville and the Improved Seville, both being similar. The Poorman and the Omi Kin Kan are frequently referred to as bitter oranges, but these varieties will be dealt with under the heading of grape-fruit. Both of the Seville varieties are very useful in the making of marmalade, but are seldom used for any other purpose, and even for marmalade other varieties of citrus have of recent years to a large extent taken the place of the Seville.

Lemons.

In the warmer parts of New Zealand lemon-trees grow to perfection; the fruit produced is of a very high standard, and for all general purposes equal to the best imported lemons. The tree is somewhat more readily damaged by frost than is the orange. The mature wood and foliage of the lemon will sometimes stand seven or eight degrees of frost, much depending on the type of frost experienced; however, the tender autumn growth may be cut by a comparatively light frost. It is general for the lemon to produce a considerable growth of young shoots in autumn, whereas with the orange there is usually no further shoot-growth after late summer. It is principally this difference in habit of growth that makes the lemon more susceptible to frost damage than the orange.

There are many lemon-trees growing in the South Island which are giving very satisfactory results. However, it would be unwise to plant for commercial purposes south of the Auckland Province unless in exceptionally warm and sheltered localities. There is perhaps one exception in this particular, and that is the Meyer variety lemon, which will be referred to a little later on. New-Zealand-grown lemons that have been picked at the right stage of

maturity will, when stored under suitable conditions, keep from two to four months and sometimes even longer, without showing signs of decay or the fruit wilting excessively. Unfortunately, a number of lemon-growers still persist in allowing the fruit to remain on the trees until fully coloured, and then placing this tree-ripe fruit on the market immediately it is picked. The keeping-quality of fruit handled in this way is far from satisfactory, and often creates the false impression that all New-Zealand-grown lemons are of a similar nature, which is very unfortunate, as by far the greater quantity are of excellent keeping-quality.

No less than a dozen distinct varieties of lemon are at present being grown in this country. Two of the oldest and best-known varieties are the Lisbon and the Eureka. These varieties are still the most popular for commercial planting, although other varieties appear to have certain advantages. The Lisbon produces a nice, even-sized fruit, is a heavy cropper and a vigorous grower, and possibly ranks first for commercial planting. An unpleasing feature of this variety is that the tree is inclined to be thorny. The fruit of the Eureka variety is larger than that of the Lisbon. It has the advantages over the Lisbon of being thornless and of producing a heavier summer crop.

The Meyer lemon, referred to earlier, is a comparatively recent introduction from North China. It is a dwarf variety and produces very heavy crops, even in the first year after planting. It is more resistant to frost damage than any other variety of lemon, being reported as standing up to twelve degrees of frost. The fruit is smaller than the ordinary lemon, and the acid lemon flavour is not so pronounced as in other varieties. In localities where most varieties of lemons are seriously affected by frosts the Meyer variety will prove very satisfactory for household requirements.

It may be mentioned here that the citronella or rough lemon is referred to by very many people as a lime, which is quite incorrect. The fruit of the rough lemon is orange-shaped and extremely crinkly, it has a mild lemon flavour, and the tree is very thorny. This tree is used extensively as a root stock for other citrus trees, and the fruit can be used in the same way as the lemon.

Pomelo or Grape-fruit.

This fruit, which has rapidly increased in popularity of recent years in many countries, has what might best be termed a bitter-sweet flavour. Although the fruit is used very largely for marmalade, it is also used extensively as a breakfast fruit. There are many different ways of preparing the pomelo for this purpose, but one of the most popular methods here is to cut the fruit in half across the segments, sprinkle the cut surfaces with sugar and allow to stand over night. It is usually eaten with a teaspoon before breakfast. Taken in this way it is very palatable and improves the appetite.

A number of different varieties of pomelo have been introduced to this country from America. One of the most popular of these is Marsh's Seedless. While this variety thrives and crops well in

localities where lemons succeed, the flavour is sometimes disappointing and the rind and pith very thick. It appears that the variety requires a hotter summer than we have in New Zealand to produce first-quality dessert fruit. The Poorman orange, similar to grapefruit, is also of the pomelo type, although it is often referred to as a bitter orange. This fruit, in my opinion, is the finest-flavoured breakfast fruit grown in the Dominion. The best flavour is obtained when the fruit is allowed to remain on the tree for about one month or more after ripening. The tree is a sturdy grower, and the fruit is of medium size and almost seedless. This fruit also makes excellent marmalade.

The Omi Kin Kan has a flavour almost equal to that of the Poorman orange, but it has a very rough unattractive exterior and is very seedy. On the other hand, the fruit is all of an excellent size for use as a breakfast fruit, whereas with the Poorman orange there is usually a fair proportion of the fruits which do not attain the most desirable size for use in this way.

Mandarins.

There are eighteen or more varieties of mandarins and hybrid mandarins growing in New Zealand. These trees grow and fruit well in the warmer parts of Auckland Province, but the fruit does not reach perfection in any of the varieties, owing to insufficient heat during the summer and autumn months. Most mandarins grown in New Zealand vary in size from 1 in. to 1½ in. in diameter, and are not so juicy or so sweet as first-grade imported mandarins. Larger and juicier fruit is in some cases produced on certain varieties, but the characteristic high sugar content of the juice is invariably lacking. However, certain varieties are well worthy of a place in home gardens, and the fruit produced must be considered very palatable.

A variety of mandarin that produces large fruit for our climate and is a heavy cropper is the Oonshiu. While the flavour of this variety is not so sweet as that of some other varieties, it has the advantage of growing to a very fair size, and the tree is more resistant to frost damage than almost any other variety of edible citrus fruit. Another well-known variety which can be recommended is the Emperor. Two hybrid mandarins that are reported to be proving suitable to our climate are Sampson Tangelo and Ellendale Beauty, but these varieties have not yet been grown in the Dominion for a sufficient number of years to be generally recommended.

Limes.

Very few lime-trees are growing in New Zealand compared with the other citrus fruits described, although specimens are by no means uncommon in many parts of Auckland Province. Limes will not stand cold quite as well as lemons, excepting the Rangpur variety, which is about equal to the lemon in this respect. Most varieties of limes are very similar to the lemon in flavour, but more acid. The fruit is invariably smaller than the lemon, and there is practically no commercial demand for it. The Rangpur

and the Tahiti are two heavy-cropping varieties suitable for growing in the warmer parts of New Zealand. The Persian or sweet lime has a sickly-sweet flavour, and, while the fruit can be eaten or the juice made into cold drinks, the flavour is objectionable to most palates.

Kumquats.

This kind of citrus has been introduced to New Zealand in comparatively recent years. The fruit varies in shape from round to oblong according to the variety, and is about 1 in. in diameter. The flavour of the rind is sweet aromatic, and the juice has a flavour peculiarly its own. While the fruit can be eaten fresh, including the rind, the flavour is not popular, and consequently it is more generally used in other countries for preserving and crystallizing. The tree is a dwarf grower, and is grown principally as an ornamental shrub. It is very suitable for growing in barrels or tubs when on a dwarfing stock such as Trifoliata. The Marumi, together with several other varieties, is quite suitable for growing in New Zealand. All varieties will stand more frost without injury than most other citrus trees, and the fruit is mostly produced in clusters.

Limequats.

This recent importation is a cross between the kumquat and the lime. The fruit has an acid flavour, and is about the size of the kumquat or slightly larger. The tree is very hardy and is reported to stand twelve degrees of frost without suffering injury. The juice of the fruit is very suitable for the making of fresh drinks or for flavouring.

Citrons.

Certain varieties of citrons grow to a great size, sometimes reaching 6 in. or more in diameter. A tree heavily laden with these large yellow fruits is very ornamental, and the citron is grown mostly on this account. The rind of the fruit is spongy and very thick, and the acid juice content extremely small. The fruit can be used for making marmalade if combined with other kinds of citrus fruit, and the rind is useful for making candied peel. For ornamental purposes the variety Bengal Giant is recommended, being a heavy cropper, and producing very large fruit. The Citron of Commerce variety is reported to be more suitable for candied peel.

Shaddocks.

This fruit is similar in many ways to both the pomelo and the citron. The rind is very thick and the juice content small in proportion to the size of the fruit. It is mainly used for preserving and the making of candied peel, but can also be used for cold drinks. The fruit is very large in most of the varieties and the trees are very ornamental. The flavour of some varieties is sweet, whereas with other varieties it is acid, similar to that of a lemon. The Manilla variety is suitable for the making of marmalade, has sweet juice, is a good cropper, and is probably the best suited to our climate.

PASTURE TOP-DRESSING TRIALS IN WELLINGTON AND SOUTHERN HAWKE'S BAY DISTRICTS.

SUMMARIZED RESULTS FOR PERIOD 1926 TO 1932.

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DURING the autumn of 1926 some twenty manurial top-dressing trials were laid down by the Fields Division in the Wellington and Southern Hawke's Bay districts with the object of providing demonstration areas for farmers' field-days and making comparisons between the phosphatic fertilizers most commonly used at that period. The experiment was so schemed that dressings of superphosphate, basic super, basic slag, and Ephos basic phosphate were replicated six times in strips 7 ft. 6 in. wide by 5 chains in length at the rate of 3 cwt. per acre. Every fifth plot was left as a control. Two cross-dressings of carbonate of lime, each a chain wide, at 1 ton per acre, were applied at intervals across the manure plots, thus giving the various combinations of each manure with lime, as well as manures and lime alone.

It was only possible to take green-weight yields from a few of the trials in the first year. These were summarized by the present writer and Mr. J. G. Gibbs in this *Journal* for May, 1927, and the general progress of the other tests was also outlined from observations.

The work has since been carried on by district Instructors, and this report is compiled from records made by them. During 1928 a certain number of trials were abandoned, and, apart from data recorded in the above-mentioned article, no further information is available. The majority of the remaining experiments were continued as observational plots, the subsequent treatment being as follows:—

1927: Half the number of phosphate plots in each experiment were re-topdressed.

1928: All plots (excluding the cross-dressings of lime) were re-topdressed.

1929: Two series, including those treated in 1927, were re-topdressed. In addition, a strip running across the phosphate plots was treated with 30-per-cent. potash at 2 cwt. per acre.

Observations of results, covering the past five years, are given briefly in the following notes:—

WELLINGTON WESTERN DISTRICTS.

J. Crombe, Paraparaumu.—Pasture very poor, composed of danthonia, crested dogstail, brown-top, and flat weeds, with a fair amount of moss. No visible effect at any time from lime applied in 1926 or from potash applied in 1929. Distinct beneficial effect from phosphates, super being at all times superior, with basic super next best, while slag and Ephos were least effective. Lime in

combination with the two latter manures had a depressing effect, and was of no assistance to either super or basic super.

Briefly, observations recorded that—(1) Super was superior at all times, both as regards immediate effect in the season of application and afterwards, and although dwindling in the second year, a slight effect could still be discerned up to the fourth year; (2) there was no building-up effect from the slower-acting phosphates; (3) the pasture was too poor to warrant expenditure on manuring, even although the effects from phosphate were striking.

A. J. Gimblett, Levin.—Good average clay loam. Pasture average. A little perennial rye-grass, cocksfoot, dogstail, white clover, brown-top, Yorkshire fog, and flat weeds. No effect noticeable at any period from lime applied in 1926 or potash applied in 1929. All phosphates had a marked effect on the herbage, super being superior at the beginning, but gradually falling back into line with other phosphates later on as the residue from the latter built up. Stock showed a marked preference for the phosphate plots. Top-dressing with phosphates—super in particular was shown to be economically sound. (NOTE.—Farmers in this district have long since become strong advocates of super.)

F. J. Boddy, Kopane.—Pasture: Dominant perennial rye-grass and white clover, with some dogstail, brown-top, and Yorkshire fog. Two experiments were laid down, one on silty soil and one on a strong loam with an admixture of peat. Observations show that at no time has any effect been noticeable by eye from any of the manures or lime. Stock did not appear to show any preference. The owner has used slag for some years.

M. Martin, Rangiwahia.—Yields in the 1926–27 season were recorded in the *Journal* for May, 1927. The pasture consists of brown-top, dogstail, trefoil, with some white clover, perennial rye-grass, and cocksfoot.

In the 1927–28 season the plots were again hayed, and green weights taken on 25/1/28, with the following results per acre: No manure, 4·28 tons; super, 6·59 tons; basic super, 5·86 tons; basic slag, 5·61 tons; Ephos, 6·30 tons. All phosphated plots yielded significantly higher than no manure, and super was significantly better than basic super and basic slag respectively. Ephos plus lime was significantly better than Ephos alone by ½ ton of green material, but, apart from this, the addition of lime to either of the phosphate treatments had no effect. This was contradictory to the results in the previous season, when lime with Ephos had no significant effect, but lime with the remaining phosphates gave increases over the phosphates alone.

From later observations up to the end of 1930 there appeared to be distinct responses from all phosphates, but no differences between them, and in the following year all effects had disappeared. Lime applied in 1926 and potash applied in 1929 did not show up at any time during the period the plots were under observation.

J. Parker, Rongotea.—A good average clay loam. Pasture: Rye, cocksfoot, dogstail, fog, with some foxtail and a little brown-top. Results of yields from this trial in 1926–27 were recorded in the previous *Journal* article.

The plots were again cut in the 1927–28 season and green weights taken on 6/1/28, giving the following results per acre: No manure, 5·84 tons; super, 7·08 tons; basic super, 7·45 tons; basic slag, 7·40 tons; Ephos, 7·18 tons. All phosphate treatments yielded significantly higher than no manure, but there were no significant differences between the various phosphates. Lime was significantly higher in yield than no manure, and Ephos plus lime gave a significantly higher yield than Ephos alone. The combinations of lime with the other phosphates gave no significant increases, although in the previous season significant increases were recorded when the phosphate plus lime plots were compared with phosphates alone.

Although no applications were made in 1929, the controls could still be picked out during the following summer, but thenceforward no differences could be detected.

H. McMillan, Glen Oroua.—A rich loam, with dominant rye and white clover, with some dogstail and brown-top. This trial was harvested on 19th December, 1928, and the following green weights per acre recorded: No manure, 11·5 tons; super, 10·9 tons; basic super, 11 tons; basic slag, 11·2 tons; Ephos, 11 tons. There were no significant differences between the treatments, and lime had no effect on yield. This trial was discontinued in 1928. It afforded a similar case to Boddy's, where no differences could be detected by eye at any time.

Henson Bros., Sanson.—All phosphates showed definite results, with super clearly superior, but little difference between the other manures. There was no evidence to indicate that lime was beneficial, and potash showed no results. This trial was last top-dressed in 1928, and terminated in 1930.

W. McKay, Apiti.—Light porous loam. Pasture: Rye, cocksfoot, dogstail, fog, with some brown-top. Phosphate responses were very good—super being much superior. No effect from lime could be discerned. This trial was terminated in 1928. Observations indicated that phosphatic top-dressings were economically sound, with super for preference.

A. H. Falloon, Wangaehu.—A medium heavy clay loam. Pasture: Rye, cocksfoot, dogstail, white clover, with some fog and brown-top. The phosphate plots showed up distinctly in the earlier stages, super being superior up to 1929, but at the end of 1929 no differences between phosphates could be detected. Slag eventually showed slightly to advantage, with Ephos inferior to the others. No further dressings were applied after 1930, but the phosphate plots could still be picked out during the following year, though no differences between them could be noticed. Potash appeared to have a depressing effect at one stage, and at no time appeared to advantage.

Wellington Eastern Districts.

J. C. Bidwill, Kahutara.—A heavy clay loam. Pasture: Dominant brown-top, with some rye, cocksfoot, dogstail, and white clover. The phosphates had a stimulating effect, especially super plus lime in the beginning, while slag appeared slightly superior in the second season. At the end of 1929 no differences between the phosphate

plots was observed, except that the pasture on the slag plots appeared to be of better composition. Ephos plots were not as well grazed as the others. There appeared to be a slight lime response, but later this disappeared. The supered plots appeared slightly superior again in vigour in 1930. No effect was detected at any time from potash.

P. D. Wilkie, Martinborough.—A medium clay loam. Pasture: Rye, cocksfoot, dogstail, with some white clover and brown-top. Basic super and super and lime showed up superior to slag and Ephos from the beginning, and all showed to distinct advantage over controls, which were neglected by stock. By 1929 basic super showed the best bottom, and appeared to be better grazed than the other phosphates. At this time sorrel began to show up on the unlimed areas, but was entirely absent on the limed areas. In 1930 the super and lime plot was superior to basic super, while Ephos was little better than the controls. Slag appeared to encourage more clover than the others. No potash effects were noticeable at any time.

W. A. Miller, Kaiparoro.—A medium clay loam. Pasture: Rye, cocksfoot, dogstail, fog, white clover, and some brown-top. This test comprised only super, slag, and Ephos, and no lime or potash. All three phosphates exerted a marked influence and attracted stock, the slag plots being very closely grazed. The order of superiority was slag first, super second, and Ephos third. Kaiparoro, it may be noted, is a locality of high rainfall.

Southern Hawke's Bay.

L. Wright, Makotuku.—Light loam on shingly subsoil. Pasture: Dogstail, danthonia, trefoil, with some white clover. A marked response to lime was noted in 1929. Stock had grazed the lime strips closely. Super was slightly better than the other phosphates, and was more evenly grazed. All phosphate plots showed a marked superiority in the development of white clover replacing trefoil. No applications were made after the spring of 1929, and at the end of the autumn of 1930 the effects of the phosphates were still noticeable. Lime appeared effective in 1929. Potash was not effective at any time. No observations were made after 1930. Super plus lime would appear to be economically sound. Super is now extensively used in this district.

N. Inder, Piripiri.—An average loam. Pasture: Rye, cocksfoot, dogstail, white clover, brown-top, and danthonia. This trial showed marked responses to phosphates at all times, super being superior both as regards immediate and also lasting effect. Ephos was definitely inferior to the other phosphates. Lime and potash applications did not appear to exert any influence at the beginning, but later on showed fleeting responses at various times. Observations indicate that phosphatic top-dressing is economically sound —preferably super –but there is no definite evidence that either lime or potash would prove profitable.

Summary.

As a result of observation, and in some instances the recorded weights of green material, the following general conclusions have

been arrived at in respect to manure responses in the three main districts :—

Wellington Western.—Excepting the instances of Boddy, Kopane, and McMillan, Glen Oroua, phosphates were clearly effective, and in some cases the residual effect could be detected upwards of four years after application. Of the phosphates, the indications are that super should be used for preference under average conditions. Lime applied in 1926 was effective in only two instances—those of M. Martin, Rangiwahia, and J. Parker, Rongotea, as recorded by significantly higher yields of green material in 1926–27 and 1927–28. Applications of potash did not show any response.

Wellington Eastern.—Basic slag appeared to be slightly superior to super, and this may be accounted for from the fact that all the experiments were laid down on fairly heavy clays, which are not altogether typical of the greater part of the Wairarapa Plain. Within recent years a fair amount of liming has been carried out on similar country with satisfactory results, and super has since become the popular manure.

Southern Hawke's Bay.—In three experiments super was outstanding and Ephos the least effective. The effect of phosphate applied in 1928 could still be observed in 1932. Potash appeared to have only a fleeting effect at Piripiri. Lime did not show any appreciable effect. On Gildea's farm at Maharahara in 1926–27 (see *Journal*, May, 1927) super demonstrated that rapidity of growth meant palatability, provided the pasture is controlled; and at the same time it clearly indicated that the effect of dressings of super in early spring demanded greater care and attention in grazing control than with the other phosphates used.

CIDERMAKING AND CIDER APPLES.

THE following useful note on cider is extracted from Lord Bledisloe's Cawthron Lecture of 1932, "A Conspectus of Recent Agricultural Research" :—

In connection with cider, the difficulty of controlling fermentation, which is a vital condition of the production of a high-quality beverage of uniform, and, therefore, marketable character, has been overcome by the introduction of the Seitz filter, by means of which a germ-free liquor can be obtained and the risk of subsequent disorders consequently minimized. The centrifuge, which is being employed extensively in the place of the filter, can in many respects serve the same purpose and indeed is in some ways superior to it, particularly as regards speed of working and the retention of flavour and "body" in the treated liquor. With the combined use of the centrifuge and filter it is now possible for the cider-maker to obtain natural sweetness in cider and to control fermentation more efficiently than if he used the filter only.

If cider of the finest (uniform) quality and moderate alcoholic strength is to be manufactured in New Zealand for export as well as for local consumption (and there is probably no part of the world better suited for its successful production than the provinces of Nelson, Marlborough, and Hawke's Bay in this Dominion), there will need to be put in hand the planting *ad hoc* either of choice cider varieties of apple, such as Kingston Black or Foxwhelp, or of "bittersweet" varieties, the juice of which can be blended with that of the dessert varieties normally raised in this Dominion but not of sufficient perfection for export to Britain. Cider made only from sweet table apples is apt to be a heavy beverage of high specific gravity before fermentation and ultimate excess of alcoholic strength.

THE CHEMISTRY OF WEED-KILLERS.

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SOME INTRODUCTORY NOTES.

A NEW weapon in war usually passes through many improvements towards perfection before reaching that state reasonably safe to the user and yet deadly to the enemy. The farmer is continually at war with all sorts of unwanted forms of life manifested as diseases in his stock and crops—weeds in his lands and waters, or excessive wild animal life (mice, rats, rabbits, insects, and other pests). Against all these he has to arm himself and learn to use his weapons so that, while quickly fatal in their operation against his foes, they are harmless to himself and his friends.

Farmers have thus had to learn how to handle and use in safety deadly poisons such as arsenic and the cyanides, and compounds like sodium chlorate which can, in contact with inflammable material, cause the mixture to instantaneously ignite and, under certain conditions, to explode. Other substances such as phosphorus require great care, as they spontaneously ignite in air. Some are dangerous to life owing to poisonous fumes, such as phosphorus, carbondisulphide, and the cyanides.

The principles guiding the selection of weapons of attack are many, and in the case of weed-killers it is usually easier to choose one when the plant it is desired to exterminate is very low in the scale of plant life, such as a fungus, than when it is desired to eliminate a higher or flowering plant growing together with useful forage plants. When the announcement that sodium chlorate would destroy ragwort without harm to the pasture plants was made, the statement was received as too good to be true by some who apparently had not heard of the common European practice of eradicating charlock (wild mustard) from growing wheat by means of a copper sulphate spray. An example of the selective poisoning of animals receiving official sanction in England and America is the destruction of rats by means of "Red Squill" preparations, which are fatal to rodents but harmless to man and domestic animals.

It has been a recognized practice for many years to remove broad-leaved plants from bowling-greens, putting-greens, &c., where a pure sward of grass without clover is desired, by means of nitrogenous fertilizers which so stimulate the grasses that all but narrow-leaved plants are crowded out. This fact suggests another point in the selection of the right weapon of attack, which is that if possible the compound used to kill weeds should be one which leaves a residue in the soil capable of acting as a manure and of stimulating the surviving pasture plants to cover up the gaps left by the dead weeds. This is particularly necessary when the unwanted plant is one which has the rosette type of growth, and where the space it leaves on dying is relatively large. Hence compounds of ammonium or of phosphoric acid for New Zealand soils are indicated as being of greater value than compounds which do not contain one of these ingredients, other things being equal. Thus of two compounds of equal potency as weed-killers, one of which contains a base which is of

no value and another a base which is of great value as a manurial dressing for grass, the latter will warrant selection as the more suitable, and even the payment for it of a higher price per ton.

Copper salts so generally used as fungicide sprays for vines and potatoes do not harm the host plants but are fatal to fungoid pests, and in many cases the copper salt has a stimulating effect on the host plant. The use of copper sulphate in minute amounts to kill the lower forms of plant life in reservoirs, lakes, &c., without harming other life is well known.

In experimenting with weed-killers it is essential to remember that although a compound is listed in wholesale catalogues at a price which may seem to be prohibitive, when the matter is examined in the light of mass scale production for the supply of many tons of material the price may be expected to fall greatly. Thus the price of chlorate of soda was originally quoted here at 1s. 6d. per pound, but even now under adverse importing conditions it is retailed at 6d. per pound. Undoubtedly increased demand cheapens the supply.

An example of a weed-killer which is extremely poisonous to weeds while beneficial to grasses may be quoted—namely, the by-products from coal-gas works. In order to purify coal gas from noxious compounds it is passed over limonite (hydrated iron oxide) and bubbled through water. This results in the production of certain by-products called spent oxide and gas liquor respectively. These contain substances which are at the same time poisonous to some and beneficial to other forms of plant life. Many years ago a paddock was treated at Mamaku Demonstration Farm with spent oxide at the rate of ½ ton per acre, and this resulted in the growth of a thick pure sward of grass. In larger amounts it is used to kill growth on streets. From gas liquor is obtained sulphate of ammonia, and at one time it was the principal source of this fertilizer. The amount of gasworks by-products in New Zealand is, however, too small to warrant any expectation of great relief to the farmer as sources of weed-killer.

The active poisonous principles in spent oxide appear to be compounds of ammonium, sulphur, and cyanogen, which it is essential to remove before turning the gas into the mains. One of the compounds is known as ammonium thiocyanate (NH_4CNS), and, judging from recent reports from Europe, it is possible that it will prove a highly efficient weed-killer, either alone or in mixture with certain other substances in New Zealand. The present listed price of this compound is 1s. 3d. per pound for small quantities, but no doubt if consignments of many tons were ordered the price would be much reduced. Among its virtues are that it is easily soluble in water, it is non-inflammable, and does not render fabrics steeped in it and dried inflammable, neither is it explosive when mixed with organic matters. It is fairly reasonable in price, which no doubt could be greatly reduced, and it contains the valuable fertilizer constituent ammonium. It is said to be quickly fatal to all weeds while harmless to grasses.

It is intended to devote some pages in another issue of the *Journal* to a consideration of the manufacture, composition, and properties of weed-killers, and the difficulties and dangers in using them.

(To be continued.)

SEASONAL NOTES.

THE FARM.

Pasture Establishment.

EXCEPT on localities subject to relatively early heavy frosts, autumn sowing of seed for permanent pasture is (on the basis of field experience) rightly much favoured, and generally March sowing gives best results. Frequently in March the soil possesses both the warmth and moisture which foster rapid and vigorous establishment. If the sowing is postponed until late autumn or early winter, poor establishment, particularly of clovers, is likely to occur.

The sowing of other crops, such as oats, with the pasture seeds is sometimes advocated on the ground that the companion crop will protect the pasture seedlings. As a rule, such crops which are variously called cover or nurse crops are of little or no value as a means of protection, and may readily become a cause of injury on account of robbing the pasture seedlings of moisture, and especially of direct sunlight. Such injury is likely to be minimized if the companion crop is sown thinly and not allowed to mature, but even under such circumstances the possibility of injurious shading is not completely eliminated, and so the use generally of companion crops is not recommended. Exceptional cases which justify the use of cover crops may occur in exposed situations, and in such cases white oats or barley may suitably be used. Algerian oats usually are not suitable on account of their relatively slow growth in its early stages, when shelter might be needed by the pasture seedlings.

The objective in the formation of seed-beds for pastures should be a fine, consolidated condition. When this is attained pasture seeds are usually effectively covered by a stroke of the tine harrows. If the seed-bed is loose and dry the use of the Cambridge roller after sowing is usually advisable, but if there is probability of heavy downpours of rain, it is frequently well to finish with the harrows instead of the roller, especially when the soil is known to contain an appreciable amount of fine silt, which readily leads to the formation of caked soil-surfaces after beating rains.

Official analyses of samples of the grass-seed produced during the current season disclose that, as is customary, there is considerable variation in the germination-capacity of different lines of the same species. There is also prospect of the usual range of variation in the purity of the lines. The advisability of buying seeds on the basis of their guaranteed purity and germination has previously been stressed in these notes. Lines of certified seed as well as other lines should be purchased on the basis of their germination-capacity and purity; while the amount of impurity in certified seed is limited in certain respects, it varies considerably, and the germination-capacity varies so greatly that a reliable knowledge of the germination-capacity of lines under consideration becomes a fundamental condition of businesslike purchasing. As, after machine-dressing of the seed, official data relative to both the germination-capacity and purity of all certified lines are supplied to the owners of the seed, purchasers should have no difficulty in buying on the basis of actual inspection of the official documents containing these data, which are provided for their protection.

The mixtures of seeds used in the establishment of permanent pastures should be based on the best information which is available. Unfortunately, the mixtures at times used lead to unnecessarily poor

pastures or unnecessarily heavy expenditure, or both, and so farmers who are at all doubtful are recommended to consult local officers of the Fields Division about the composition of mixtures suited to their needs.

Pasture Management.

Aspects of harrowing and autumn top-dressing of pastures are dealt with in the later reference to the special need at this season of stimulating the production of fresh leafy feed.

The current season has provided much evidence of the value of early ensilage as a means of obtaining additional fresh leafy growth on pastures for use in the January–February period, when such feed is usually specially valuable. In some instances silage was harvested in late October or early November, while in adjoining fields it was not harvested until a month or more later. During the recent dry summer spell it was frequently possible to make instructive comparisons between the fresh feed available on the fields mown at an early date and the relatively small amount on the fields mown comparatively late.

Planning for Provision of Special Feed.

Frequently it proves useful at this stage in the year's work to plan some of the field-work for the coming year in the light of experience and results already obtained during the current season. Generally, the feed position is much better than it was at a corresponding stage twelve months ago. A spring and early summer of bountiful growth have led to substantial increases in the amount of hay and silage harvested. It would be regrettable if the relatively good supplies of these feeds on hand brings about a falling-off in the amount of feed which would normally be provided during the coming year by other means. A marked and long-felt need in our farming is the building-up of adequate reserves of feed. This is particularly advisable on the part of those farmers who propose to give grass ensilage a prominent part in the work of feed provision for the periods during which the growth of grassland is usually insufficient to meet the requirements of stock.

The amount of grass silage that can be made in a season is determined so largely by the weather conditions that a farmer depending primarily on it would, without adequate reserves, be in a disastrous position should two unfavourable seasons occur in succession. The wise course would be to plan to produce during the current year the amount of special feed which past experience has shown to be adequate. And in many instances what has been produced in the past has not been adequate. So that often past production of special feed should not merely be maintained, but should be increased, if there is not to be a slipping-back to a chronic state of shortage of feed whenever a spell of weather unfavourable to grass growth is experienced.

Much of the field-work calling for attention on many farms during the next few weeks has for its object the provision of extra fresh feed during periods of scarcity of grass growth. This is true of the sowing of catch crops in the manner described in last month's notes. Should it happen that all the green feed available from such crops is not required for feeding when in the green stage, the surplus can quite suitably be used for hay or silage next season.

In preparing the land for such catch crops it is not necessary to reduce the surface layer of soil to a fine condition. Indeed the occurrence in it of small clods may at times prove a distinct advantage. The clods tend to assist in preventing the caking of the surface layer which at times takes place in a fine surface layer of soil after beating rains, and eventually the clods are suitably broken up by natural weathering agencies. Frequently quite light cultivation will provide a suitable seed-bed on land in which

a catch crop is to follow soft turnips or cereals. If the land available for catch crops is so hard as to make satisfactory skim ploughing impracticable, then often cultivation with the disks set with considerable cut will prove an effective alternative.

There has been a significant swing in popular favour to the practice of applying phosphates to grassland during the period February to April. This is due partly to the important fact that such top-dressing usually brings about, prior to the dormant winter period, a substantial and valuable increase in the growth from the grassland. If the top-dressing is done at an early enough date some of this increase may be especially useful in maintaining dairy production towards the end of the season. The heavy fall that occurs so commonly in January and February is serious, because of its direct effect on the returns for those months. But unfortunately the depressing influence goes much further, for normally a herd which falls at an unduly rapid rate at this period does not at any time during the remainder of the season return to the standard of production that it would have maintained had an unfavourable January-February feed supply not intervened. Extensive field experience has shown that phosphatic fertilizers applied in autumn continue to stimulate growth in the early spring practically to the same extent as would a similar amount of the same material applied in the spring, but the autumn dressing does not give, in the following summer, a rush of growth equal to that produced by a corresponding spring dressing. As a rule, on average to good quality land, there is room for an expansion instead of a contraction of past top-dressing programmes. And while it is clear that circumstances call for the exercise of all possible economy on the part of farmers generally, it would be false economy on the part of farmers situated on much of such land to curtail their outlay on top-dressing.

Grass harrowing as soon as good rains occur is another practice which at this season will foster the production of fresh leafy feed on pastures on which droppings have accumulated during the dry spell. Normally the essential aim of such harrowing is the distribution of droppings, and this is more thoroughly effected by two strokes of the harrows, one at right angles to the other, than by a similar amount of harrowing carried out in any other way.

Utilization of Crops.

The handling of special crops which are yielding feed in the latter part of summer is not always carried out to the best advantage. In the first place, green crops are at times allowed to become too mature and woody. This is true of such crops as green lucerne, millet, and red clover. Usually at this season the qualities vitally needed in crops being used for green feed are high digestibility, high mineral content, and high content of the protein required for milk and flesh formation. In all these there is a falling-off in green feed as it approaches maturity. From this it follows that a supply of green feed is of itself not sufficient to ensure a proper maintenance of the milk flow. The green feed must be suitably young, leafy, and succulent. For instance, while green lucerne at one stage may serve admirably to balance the excessive woodiness or stemminess in the feed available from pastures, it may at a later stage possess the stemminess which is the weakness of the pastures.

Another matter which sometimes requires attention is the utilization of special crops, such as soft turnips, not at the peak of their yield but at the peak of their economic effectiveness. A crop of soft turnips not fully grown, for instance, but used when it is most urgently required may give a greater eventual cash return than if its use were delayed until fully developed.

Thirdly, the handling of lucerne calls for special mention. Lucerne fields may reach a stage suitable for cutting at this season. After such a cutting, if weeds are menacing the crop and dry conditions prevail, it is likely to be advantageous to run over the crop with tine harrows or other

harrows fitted with teeth possessing the fine points necessary to avoid undue injury to the lucerne plants. While cultivation of lucerne at other seasons sometimes does more harm than good, cultivation at this season is likely to be particularly serviceable in checking the invasion of weeds, for the direct influence of the cultivation is supplemented by the effect of the dry conditions on the dislodged weeds.

Autumn Tillage.

There is considerable scope for valuable autumn cultivation. Frequently land on which crops of oats, wheat, and rape have been grown should be cultivated as soon as possible after the removal of these crops. This may be expected to destroy or weaken perennial weeds generally and to encourage the growth of seeds of certain annual weeds. While it is not effective in controlling directly those annual weeds the seeds of which do not germinate readily in the autumn, it may serve indirectly to check them appreciably. This is because the cultivation, by controlling perennial weeds and by improving the fertility of the soil, gives the subsequent autumn-sown crop a better chance to thrive, and a thriving autumn-sown crop is specially effective in checking annual weeds which germinate in the spring.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Spraying Operations.

SPRAYING should not be neglected altogether during February, as in many districts there is another flight of codlin-moth about the middle of the month, which should be guarded against by an application of arsenate of lead. Nicotine sulphate may be added where leaf-hopper is in evidence.

The later spraying with lime-sulphur should also be applied for the control of powdery mildew, and to avoid late infections of black-spot both on apples and pears, particularly those required for storage purposes. This spray would also prove effective in controlling red-mite.

Care in Picking.

There is no phase of orcharding that requires more careful supervision than picking. It might be considered unnecessary and frivolous to inspect the finger-nails of pickers, nevertheless a survey of the bins in the packing-shed generally reveals a fair proportion of injury due to nail-marks. Together with bruised and stemless fruits, the foregoing represent a large economic loss annually to growers.

Instruction in the proper method of removing the fruit from spur or lateral will obviate a high occurrence of the above-mentioned injuries. Care should be taken that the finger-tips are not used in this operation. The thumb should be placed at the juncture of the fruit-stem and spur, and the soft part of the hand used to twist or bend the fruit. It may be suggested that this system may seriously curtail expeditious picking. In contradiction it could be submitted that if the loss entailed through bruising, stemless fruits, broken fruit-spurs, &c., is deducted, the careful picker has a distinct economic value over the careless one in the course of a day's work.

Ruts and uneven surfaces on the road between the orchard and packing-sheds are worthy of some attention. The carter has also some responsibility as regards the care used in loading up and stacking in the shed.

Points in Packing.

A conscientious packer is one of the most valuable workers in the cycle of assembling fruit for distribution. If keen he will readily note any variation in the standard passed on from the sorters and draw the shed-manager's

attention to it. On the other hand, the ultra-fast packer is so absorbed in his record-breaking effort that it precludes the possibility of much attention being given to standards, besides neatness and attractiveness being sacrificed. It must be apparent that only the highest quality in the different standards can effectively command attention to-day, and all factors adversely affecting that result require to be eliminated.

Regarding the bulge necessary in packing, with thin flexible top and bottom case timber fruit at the highest points of the top and bottom of the case is not likely to suffer injury to a serious extent, provided the bulge is built into the pack. That is to say, fruit packed high towards the centre of the case will not suffer, neither will that towards the ends, provided allowance is made in the pack for the latter to readily press down to a level with the end boards. The idea of the flexible top and bottom boards is to satisfactorily take care of the contents of a case packed in this way.

On the other hand, if a case is packed high and no provision made for the end fruits to readily take their proper level, but on the contrary to become compact while still say ½ in. higher than the end boards, bruising must result, for this ½ in. can only be secured by one apple pressing into another. The lidding press will attend to this all right, but the result is sure to be disastrous, not only to the end fruits, but to some extent to the whole contents of the case. Packing of this kind—and unfortunately there is far too much of it—represents a misapplication of the whole bulge principle of packing, and is altogether pernicious, as a case finished in this way looks quite all right outwardly, and the grower is in consequence frequently ignorant of its inward faults, which are liable to much depreciate the sale value of his fruit.

—H. F. Frost, Orchard Instructor, Wanganui.

Citrus Culture.

Many growers will now be realizing the necessity of making provision for a period of dry weather. Where this has not been done it is possible that many trees will be feeling the effects of the droughty conditions. If copious rains fall in the near future it may be that the trees will break out into fairly strong autumn growth. Should this take place the trees should be watched and some judicious pinching be carried out in order to consolidate the lower portions of the shoots, as it is possible that this autumn growth may be carried on into the winter, and should frosts occur these young tender growths are liable to be cut by the frost.

The present embargo on Australian fruits will doubtless have the effect of stimulating the local citrus industry. However, growers would be well advised not to be carried away by any period of high prices. The value of any undertaking should be based on the nearest minimum returns for profit. If this were practised instead of basing it upon the higher values received there would be a much more reliable foundation upon which to work.

Every attention should be paid to all seasonable operations as they become due, making provision as far as possible for eventualities that may arise.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Judgment in Feeding.

THE feeding of the stock of various ages at the present time requires considerable judgment on the part of the poultry-keeper. A common mistake made in this direction is to provide the same ration to all birds. The quality of the food should be in accordance with the age of the birds and the object aimed at. For instance, if the adult birds are to give their maximum egg-yield a fair proportion of animal food is an essential. In

the case of the growing pullets, however, meat and other forcing foods should be sparingly supplied. In fact, if there is any sign of the pullets coming to maturity prematurely, these materials should be eliminated from the ration, or the birds are apt to commence laying before they reach a desired size and proper healthy development.

In reference to prematurity, a poultry-keeper who called upon the writer the other day in search of some general advice on the management of poultry was most enthusiastic over his White Leghorn pullets purchased as day-old chicks, which commenced to lay when a little over four months' old. Obviously such birds cannot grow into vigorous stock, while from a productive viewpoint they will prove unprofitable, and probably their eggs will never be of a satisfactory size. Then again, they scarcely ever make desirable breeding specimens. Furthermore, they will probably lay a few eggs during the cheap-egg season and then go into a moult with the old birds at a time when eggs command a high price.

It is true some strains mature earlier than others, but usually this premature development is due to mismanagement, principally in the matter of feeding. Unfortunately too many poultry-keepers labour under the delusion that early maturity is an indication of egg-laying and breeding power, and consequently they force their pullets to prematurity by means of rich food such as meat and so-called tonics, &c. There is no greater fallacy. The weakness in the campaign for increasing egg-yielding power is the loss of size not only in the bird but in the eggs she produces. If the good name now possessed for New Zealand eggs on the London market is to be strengthened, or even maintained, poultry-keepers should heed the warning and endeavour to correct this tendency before it is too late. If any example is needed to prove that the small-egg question is becoming a serious matter from an industry standpoint, it is surely contained in the fact that out of the total of 5,264 cases exported to London during the recent season no less than 2,723 cases contained eggs weighing less than 2 oz.

The Breeding Cockerels.

It is now full time the early hatched cockerels were gone through and the best specimens selected for future breeding purposes. In this connection it is always a good plan to select about double the number of males actually required, for some of the birds may have to be rejected at a later date. It often happens that a male when young looks very promising, only to prove disappointing when a more developed stage is reached. Do not select a cockerel for the breeding-pen that shows evidence of coming to maturity at an extremely early age. These seldom or never grow to a desired size, and therefore prove next to useless when the mating-time comes round. As a general rule, it is the big-framed slow-maturing male bird that makes the best sire.

Size does not necessarily mean that because a bird gives promise of being a large specimen of its breed it will make an ideal breeder. Something more is required. As with the breeding-hen, constitution should be given the first consideration, but type, size, breed points, and a knowledge of his ancestors must be taken into consideration. The bird which, when from four to five months' old, exhibits a well-grown frame, with good crop and chest development, and at the same time possesses the maximum number of constitutional points, is the one that should be chosen in preference to a bird of the same age that gives evidence of prematurity. It is generally considered, and rightly so, that a good big specimen of the breed is better than a good small one, all other points being equal; but breeding for size alone can be easily overdone, at the expense of the egg-basket. If the weight clauses allotted for the various breeds of useful poultry in the Dominion Utility Poultry Standards are adhered to, these will be a sufficient guide in the matter of weight.

The chief points indicating stamina are a bold prominent eye as fiery as possible, a clean, well-coloured face, a short, well-curved beak, a broad but neat head, tight feathering, well developed crop, and short shanks set well apart, which give the body a well balanced and active carriage. Never breed from a male with knock knees, long shanks, a spare crop, or one having feminine characteristics, as these usually indicate lack of vigour, and when bred from are generally followed by a full measure of disappointments. The breeding male should be in every respect masculine, and, while having the necessary weight, should possess a certain amount of refinement, of which fine texture of comb and face are desirable. It should not be forgotten that the male is more than half the breeding-pen, as he leaves his influence on every chicken hatched from him. Not only should he be of undoubted stamina and utility quality, but he should have every opportunity for developing naturally and maintaining himself in the best health possible. In addition, he should be the son of a great layer of good marketable eggs.

Many poultry-keepers after selecting the most promising cockerels for future breeding purposes place them in small coops or confined quarters. This is a mistake, as such conditions do not tend towards promoting vigorous and healthy growth. Confinement is necessary in priming cockerels for the table, but it is most undesirable in the case of those it is intended to breed from, as it has the effect of overforcing the birds, a common cause of leg-weakness and other troubles such as falling-over combs, &c. There is no better way of promoting good health and vigour than by giving the growing bird, whether male or female, a good range under the most natural conditions possible. It goes without saying that this should go hand in hand with good breeding, housing, feeding, and generally efficient management.

Double-yolked Eggs.

These are caused by two yolks falling from the egg cluster into the oviduct at about the same time and becoming enclosed within one shell. Sometimes three yolks leave and pass down the oviduct together and then a triple-yolked egg is formed. The ovum or yolk is generated in the ovary, and as soon as it ripens there is a rupture of the ligament by which it is attached to the ovary. Then passing down the oviduct it is first impregnated, coated with layers of albumen, and finally receives the shell membranes and outer shell. Disorders whereby two or more ova fall almost simultaneously from the egg cluster are usually the result of overfeeding of nitrogenous matter such as meat, meat-meal, or milk. Condiments may also be responsible, and should not be fed in any shape or form to laying birds. They simply overirritate the ovaries, and although a few more eggs may be gathered when first given, a reaction sets in and the hen soon falls a victim to some disorder.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Use of Bee-escapes.

For removing honey late in the season the beekeeper may find it necessary to bring into use bee-escapes. These escapes enable the honey to be removed without causing any disturbance. By the employment of the Hodgson escape device there is less likelihood of causing robbing, with its attendant evils.

More especially will the escapes be found advantageous when removing section honey from the hive. There is far more risk in removing sections

than extraction-combs. When the colony is disturbed the bees will at once start to fill their sacs, and often the cappings of the sections are punctured in order to secure a supply of honey. The damage is unsightly, and causes the honey to leak after removal from the hive. The special advantage of the Hodgson escape is that, being constructed of wire gauze, the heat from the brood-chamber is not shut off from the super after the bees have escaped. Thus the honey in the super is kept warm, and the drips of honey from the burr combs are cleaned up by the bees.

When inserting the Hodgson escape the super should be gently prized up from the brood-chamber and the escape placed in position. A puff of smoke will suffice to control the bees while the operation is being performed. If this is done late in the afternoon the bees will pass through the escape during the night to the brood-nest, and will be unable to return. In the morning the supers may be removed, when practically no bees will be left in the super.

A word of caution to those who have not formerly used the escapes: Should there be brood in the super combs the bees will not leave, and the escapes will not prove effective in ridding the supers. Over and over again many beginners complain that they cannot get the bees to leave the supers when using escapes, but the reason lies in the fact that no examination had been made to ascertain before-hand whether the super contained honey only.

Uniting Weak Colonies.

Among the autumn work to be attended to is the examination of the colonies for the purpose of ascertaining if each possesses a laying queen, and to note those that are too weak to survive the winter. In the negative, in either case, it is advisable to unite with a stronger colony so as to save the bees. On no account should an attempt be made to winter weak hives, as they are likely to get robbed out, and this may cause the bees to start robbing when everything in the apiary should be quiet.

A simple method of uniting may be practised by placing the weaker hive on top of a stronger one, and putting a sheet of newspaper between the two hive-bodies. In the course of a few days the bees of the weaker colony will make their way through the paper and unite peaceably with the bees in the stronger hive. The surplus combs may subsequently be removed and reserved for spring feeding if required. It is advantageous to destroy the queen in the weak hive prior to uniting.

Precaution against Robbing.

At the close of the honey-flow the beekeeper must persistently guard against robbing. Robbing is the result of carelessness, and once it has started is exceedingly hard to check. As previously mentioned, neither honey, sugar-syrup, nor anything that the bees can rob should be exposed. In case wet combs have to be returned to the hives for the bees to clean up, postpone this operation until late in the day, when robbing is not likely to start. See that the honey-house is bee-proof, and that all combs and vessels containing honey are removed to a place of safety. Contract all hive-entrances, and especially guard against hives being open in such a way that they can be attacked by robbers. All operations must be carried out quickly. If robbing has started, it is better to postpone all outside work until the apiary is quiet again than to risk extending the trouble by opening the hives. Should a colony be attacked, contract the entrance and pile wet grass in front of the hive. This will usually cure mild cases of robbing; but where a colony has been overpowered by the robbers it should be closed altogether.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Vegetable-growing.

MUCH of the trouble with pests and diseases attacking crops may be avoided by arranging a suitable rotation or succession. It is an interesting and peculiar fact that these parasitic organisms generally have a very limited range of hosts; most of them attack only one plant family, and sometimes even only certain varieties of that family are seriously affected for some unknown reason. The others are then spoken of as being more or less immune or blight-proof. So that soil that has become contaminated with disease affecting one kind of crop will make our work exceedingly difficult if that crop is planted again on the same ground now or before the trouble has had time to die out. By planting crops of a different kind for a period the parasitic organism in the soil will die out for want of a suitable host.

There are other advantages in arranging a suitable succession of crops; for instance, some are surface-rooting, and if such crops are repeatedly planted in the same place they can only be successful by the extravagant use of manures, and plant-foods accumulate at the lower levels and remain to a great extent unused. For this reason it is economical to arrange for deep-rooting crops to follow the shallow-rooting kinds. Again, some classes require special preparation. Crops with long tap-roots usually grow best in ground that is deeply trenched and is free from fresh manure, but rich in manures applied for previous crops that have become well incorporated with the soil. The roots are then clean and shapely. Another class, the brassica or cabbage family, requires a rich soil, but one that has been well limed.

To grow clean crops economically the problem of arranging a suitable succession has to be carefully considered. Where a great variety has to be grown this is not always easy, neither is it easy sometimes where the range is limited to a market demand. The rotation decided on will vary according to the different circumstances, but for general home garden purposes, and as an example, the following is a useful guide.

Divide the ground into three equal portions. Then prepare one for deep tap-rooted crops, such as carrots and parsnips, by trenching it well. With a little superphosphate hoed in shortly before sowing the crops, it should then do very well. Another plot should be turned over and generously supplied with humus in the shape of farmyard manure or green cover-crops grown on the spot or collected elsewhere. With suitable chemical fertilizers hoed in before sowing or planting in the spring, the ground will be suitable for such shallow-rooting crops as beans, peas, onions, spinach, salads, &c. The third plot, prepared in the same way, should be reserved for winter and spring cabbage, cauliflower, broccoli, kale, &c., applying before planting ½ lb. to 1 lb. of finely ground limestone or slaked burnt lime to the square yard, the latter being used on heavy ground.

If these principles are strictly maintained the work in the vegetable garden will be greatly simplified, and better crops will be secured. In detail there are some adjustments and compromises to be made at times. For instance, while the spring cabbage and cauliflower crops are planted about the month of April, the winter crops of savoy, cauliflower, &c., are not planted until December or January, so that a large portion of the third plot would be lying vacant for six months. As that is unreasonable, it may be planted with such crops as early potatoes and peas, which will be out of the way in time for planting winter cabbage crops (brassicas). In such a three-year course as that described the whole of the ground is trenched, limed, manured, and plant troubles to a great extent avoided by changing the crops and treatment of the plots each year, the treatment following the order given. Where the land is heavy, winter trenching and digging

should be done as soon as possible, leaving the surface rough so that it will be well-weathered and a fine tilth more easily obtained when planting-time comes.

In the moister districts where it is the custom to set out onion plants in the spring, instead of sowing at that season, the seed should be sown during the month of March. European seed is quite suitable for growing onions to be pulled young for salads, but where good bulbs are desired it is necessary to sow a good strain of New Zealand or Australian-grown seed. Sow a generous area thinly; what is not used for planting will be appreciated as a contribution to the salads. Sow also lettuce and radishes, and for spring cutting a good width of spinach.

The Tomato Crops.

Where leaf-mould has been troublesome in crops under glass the plants should be lifted and burnt, and the house thoroughly fumigated to destroy the abundant spores lodged everywhere about the building. Unless the house is thoroughly cleaned up and the ground put into good order there is only disappointment coming next season. Some evening in calm weather shut the house up tight, burn a quantity of sulphur, and the sulphur dioxide gas given off will do the good work. One pound per thousand cubic feet is a sufficient dose. To obtain a quick generation of the gas do not burn it all in one heap, but distribute it equally in half a dozen heaps on the ground and set them all alight. Retire and lock the door, using a wet sack to seal any opening there may be where the door does not fit tight on the sill. This method was fully described in the last September number of the *Journal*, on page 141. There are very few houses that would not benefit from this treatment so soon as the present crop is finished.

Regarding the atmospheric humidity of houses, which is the main factor in the spread of this fungus disease, regular attention to ventilation by an experienced person during early summer, when the danger is greatest, is quite effective in some places, but not in others. In the latter case it appears the experience may be due to a high water-level in the soil, and that better drainage by means of tile pipes or even open drains would improve the conditions. Undoubtedly in wet districts, especially where the land is heavy, such treatment can be relied upon to be of great assistance in preventing the attack of this disease. Great assistance would also be gained by fixing guttering at the eaves to carry off the rain water satisfactorily; only on land with a shingle subsoil or where drainage is exceptionally good can it be dispensed with.

In many districts the outdoor crops have suffered from wilt diseases; of these there are many, but two only appear to be prevalent here. The one commonly known as brown-top in some districts has been identified as *Verticillium albo-atrum*, and this has caused most loss. The other, known scientifically as *Fusarium lycoporsici*, is occasionally met. Every one interested in tomato-cuture should study carefully the account of these troubles and their treatment in last month's *Journal*. Some of the resolutions made by those who do so will no doubt include the use of sterilized soil in the seed-boxes; to lift and carefully destroy infected plants; to select for seed-saving purposes not merely the finest fruits, but the healthiest plants. This is not so much to avoid infected seed, as that has not been proved in this instance, but it will have a tendency in the direction of securing a strain with some resistance to the disease. In both instances these are soil fungi which attack the roots, so sprays are useless. Under glass they can be destroyed by sterilizing the soil—a method that is not practicable outside. As always, sturdy growth is one of the best ways of preventing trouble; it is the weaklings that are most susceptible.

Small Fruits and Nuts.

Where new plantations of these crops are contemplated, it is important to give consideration to the suitability of the land and climate. Much can be done under adverse conditions, but only at the expense of a great deal of extra attention, which can be avoided if the right crops are chosen; the results are also infinitely better where the conditions are naturally suitable.

In higher altitudes and lower latitudes—that is, in the cooler districts—gooseberries, currants, and raspberries thrive best. In such localities, on good deep moist loams, raspberries and black currants do well; light lands are suitable for gooseberries and red currants. The strawberry crop is less restricted to climate, as it fruits well in both warm and cold localities so long as it has a heavy moist soil that is well-drained.

In the warmer districts loganberries, Cape gooseberries, tree-tomatoes, Chinese gooseberries, feijoa, passion-fruit, guavas, loquats, figs, and the grape-vine thrive. Most of these require a good moist well-drained loam to crop really well, but the Cape gooseberry requires a rich light soil, and the vine has a wide range of adaptability. Good shelter is necessary especially for tree-tomatoes.

Walnuts do exceedingly well in this country on good alluvial lands in the localities with a moderate rainfall. Useful supplies may be obtained by selecting the better varieties and planting them as an avenue or as shade trees. On warm hillsides the stone pine (*Pinus pinea*) crops abundantly, and the kernels are much appreciated by those who have used them. In a similar situation in districts with a greater rainfall the sweet chestnut is at home and crops well with little attention. Hazelnuts and filberts are not so particular as to temperatures. On land of moderate quality in localities with a good rainfall many plantations are carrying satisfactory crops. Almonds are cropping well in the eastern—that is, the drier districts of the North Island. They require good land with an open subsoil. The chief difficulty with the almond and hazelnut is the fact that they are practically all self-fertile, and compatible pollenizing varieties must be interplanted to ensure good crops.

If planting plans are in this way made to harmonize with the environment, one of the chief difficulties to successful cropping will be overcome, and good supplies may be obtained with comparative ease.

The Homestead Garden.

Where new gardens or alterations are being made a good design sometimes fails because the surface levels and grades are weak or not well chosen. A lawn or walk that sags has a deplorable appearance, and unless it is well drained it soon becomes worse. A slight fall in the surface levels is necessary to run off storm-water, and this should always be provided, with suitable drains, where necessary, to carry away the water. The grades are governed in the first place by the entrances to the dwelling, and usually the ground-line about a house should be level, with the surface falling gradually and evenly away from it. It may be broken by a terrace, but it should then be resumed. If the natural lay of the land runs upwards—which is rather awkward, but sometimes happens—the fall of the surface from the house must terminate in a watertable at the foot of a rising terrace. Again, the two watertables of a walk or drive should both be on the same level and evenly graded to the garden gate or entrances, which generally control the height of the lower levels. Many problems sometimes arise in this connection, but any consideration given to the subject will greatly improve the appearance and permanence of the work. The levels are obtained by driving in pegs, a few yards apart, at the right level, this being ascertained by the use of three tee or boning rods.

A garden that is graded and drained effectively can hardly fail to look and do well whatever the design may be. In districts with a heavy rainfall the watertables must not be overloaded or they will scour; sumps and culverts must be provided to divert the water.

—*W. C. Hyde, Horticulturist, Wellington.*

RESEARCH WORK ON PHORMIUM TENAX.

THE following report for 1931–32 was made to the Phormium Committee of the Council of Scientific and Industrial Research by Dr. J. S. Yeates, who is in charge of this work at Massey Agricultural College:—

Progress during the period under review has consisted mainly of the normal development of the selection and hybridization scheme originally undertaken. The "fans" planted for rootstock selection are in many cases now old enough for their fibre qualities to be judged, and it is evident that several strains of very high quality have been secured. The selection of strains resistant to yellow-leaf disease requires a longer period, since it is unsafe to base conclusions on the immunity of only three or four plants. Several otherwise good strains have already been shown as most susceptible to the disease. The number of varieties collected as "fans" has not increased greatly during the year, on account of the reduction in travelling.

Hybrids.—The first hybrid plants are now four years old. They are mostly the result of crosses between S.S. (resistant) and 13 K (less resistant). Most of these are now large bushes about 9 ft. or 10 ft. high, and some already have been culled out on account of susceptibility to disease. The more promising of these bushes have been broken into "fans" and set out in order to increase stocks and to test them further for disease resistance. Other hybrids, mainly between S.S. and Ngaro, to the number of about twenty thousand are being grown for selection of the best types.

Pedigree Seedlings.—The seedlings grown pod by pod for a study of inheritance and to develop pure lines have grown excellently. It is already apparent that while the seedlings, in general, breed true to the parent in habit of growth, yet there is great variation in leaf and fibre characters. Genetical study of pedigree seedlings and of hybrid seedlings has provided a great deal of interesting material concerning the inheritance of certain characters. It is not proposed to publish the results until they have been tested by further hybridization during next summer. Several thousand two-year-old and three-year-old pedigree seedlings are being destroyed, since lack of money prevents their being set out in a plantation.

Yellow-leaf.—Since Mr. Meadow's appointment terminated, at the beginning of the year, no laboratory work on the cause of this disease has been possible. A considerable amount of observation has been carried out concerning the onset and progress of the disease. This has been facilitated by the considerable and not-unexpected spread of the disease in our main area. Selection and hybridization to secure resistant strains is still the main line of attack on this disease.

Manurial Trials.—These trials were set out largely in order to test the effect of fertilizers on yellow-leaf disease. In the main trial area careful examination shows that so far none of the dressings has any effect on the disease. The plots treated with blood-and-bone are showing the best growth on the College farm. On account of the curtailment of travelling, it has not been possible to keep under observation the manurial trials in other districts.

Growth of Leaves.—In August, 1931, there was taken in hand the careful measurement and recording of growth in leaves. This was carried out on some fifty plants of vegetatively propagated Ngaro, and provided some interesting results. The work required about two days in each week, and when economy made it necessary to dispense with our laboratory assistant in December the work could not be carried on. Growth in length of approximately 2 in. a day was recorded at times. Comparisons of leaf-growth between healthy and yellow-leaf-affected bushes gave especially significant results.

Fibre-testing.—Preliminary work has been carried out in an attempt to find the most accurate and rapid method for testing fibres without previously passing them through a stripper. It has been found that fibre hand-dressed from leaves in the Maori fashion does not give a true criterion of the strength of the total fibre of the leaf. The search for an accurate testing method is being continued.

WEATHER RECORDS: JANUARY, 1933.

Dominion Meteorological Office.

THE weather during the month was on the whole warm and sunny, with little wind. Though rainfall was below normal in most places, there was much muggy, humid weather.

Rainfall.—As a rule the rainfall was considerably less than the average, but the deficits were very variable owing to the irregular nature of the rains that did occur. In the South Island there was much more than the normal in most of Nelson and Westland and much of the high country of the interior. The same is true of the north-eastern portion of the North Island. In Taranaki, inland districts fared better than the coast. In the Manawatu the distribution was very patchy, some places being very dry, while in others good rains were received. The lack of rain is being felt most acutely, perhaps, in parts of the Waikato country. At the end of the month there seemed a likelihood of the dry conditions in Marlborough and Hawke's Bay being relieved. Thunderstorms were rather numerous, and several cases of severe hailstorms were reported. A tornado in the Te Awamutu district on the 19th was responsible for some damage.

Temperature.—Temperatures were everywhere above the normal for the month, many places having the warmest January since 1924. The average was usually exceeded by about one degree Fahrenheit. There were some very warm days in the middle and at the end of the month, numbers of places in eastern districts of the South Island recording over 90° F.

Sunshine.—In spite of much humid weather, more sunshine than usual was experienced. Of the returns to hand, Nelson with 284·6 and Blenheim with 284 hours furnished the highest totals.

Pressure Systems.—The outstanding feature of the weather charts for the month, as in the previous one, has been the general low pressure and the disturbed conditions prevailing in the tropics. This had a great influence on the weather in the Dominion and produced unhappy conditions for the forecaster, since it resulted in the normal eastward movement of disturbances being interfered with.

For example, a moderate westerly depression passed eastward on the 2nd, and on the 3rd an anticyclone commenced to follow it on to the Dominion. This would normally have meant that the southerly winds which had set in would have gradually died down and veered to warm northerlies as the centre of the anticyclone passed, but at this time a tropical cyclone which was encountered during the night of the 4th to 5th January by the s.s. "Maunganui," near Rarotonga, was passing through the Pacific Island Groups from north of Fiji to south of the Cook Islands. The effect of this storm was to cause the pressure to remain low to the east of New Zealand and southerly winds to continue.

Next, another tropical cyclone, which was first heard of on the 8th, moved very slowly almost in a due southerly direction, and it was not until the 17th that it finally filled up and disappeared when centred north of East Cape. For some days it produced dull, unsettled weather in the northern part of the Dominion with irregular rains, among which were many heavy falls. Elsewhere, although the atmosphere was very sultry and humid, little rain fell. The westerly depressions were, in the meantime, held up.

On the 17th, however, a deep westerly depression did move onto the South Island. This was successively rejuvenated so that it was not until the 22nd that it finally moved away. Muggy weather, with rains of irregular character, continued throughout this period.

An equally slow-moving anticyclone then took the place of the depression, and fine, cool weather prevailed at most places until the 28th when a fresh and complex depression commenced to affect our weather in a series of waves. Warm and humid conditions again set in. As a result of heavy rains on the 30th and 31st there was severe flooding in northern Nelson and Marlborough, and in Westland. In the Rai Valley, 20 in. fell in less than two days.

—Wellington, 6th February, 1933

RAINFALL FOR JANUARY, 1933, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average January Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kaitaia	1·05	6	0·38	4·06
Russell	0·88	8	0·30	3·35
Whangarei	1·94	10	0·52	3 92
Auckland	1·48	12	0·77	2·74
Hamilton	2·19	8	0·75	3·78
Rotorua	5·56	11	2·15	4·21
Kawhia	2·12	10	0·55	3·56
New Plymouth	2·41	14	0·60	4·20
Riversdale, Inglewood	6·45	15	1·50	7·56
Whangamomona	5·92	8	1·75	5·65
Hawera	3·37	10	0·90	3·60
Tairua	8·04	14	2·48	3·75
Tauranga	4·21	12	1·10	4·17
Maraehako Station, Opotiki ..	8·03	13	2·02	3·59
Gisborne	4·56	11	2·00	2·74
Taupo	2·65	12	1·39	3·41
Napier	0·88	8	0·38	3·02
Hastings	1·33	12	0·60	1·97
Taihape	2·98	11	0·95	3·27
Masterton	0·89	8	0·33	2·63
Patea	3·49	8	2·12	3·62
Wanganui	3·21	11	0·78	2·86
Foxton	2·48	7	0·82	2·20
Wellington	2·07	13	0·53	2·81
South Island.				
Westport	11·65	19	2·71	8·20
Greymouth	9·61	16	2·20	9·26
Hokitika	13·84	16	3·29	9·89
Ross	16·53	13	3·95	12·07
Arthur's Pass	17·83	14	6·90	14·02
Okuru	..	..	..	12·33
Collingwood	12·35	12	3·61	6·60
Nelson	7·39	9	3·50	2·80
Spring Creek	1·85	10	0·77	2·22
Hanmer Springs	1·94	8	0·68	3·93
Highfield, Waiau	2·00	6	0·67	3·01
Gore Bay	2·43	6	0·74	2·54
Christchurch	2·15	12	0 51	2·20
Timaru	1·75	12	0 63	2·28
Lambrook Station, Fairlie ..	3·26	10	0·74	2·44
Lenmore Station, Clearburn ..	2·39	10	0·61	2·76
Oamaru	1·93	13	0·45	2·04
Queenstown	2·36	11	0·64	2·89
Clyde	1·59	9	0·54	1·82
Dunedin	2·86	14	0·57	3·42
Wendon	1·42	4	0·57	3·22
Gore	1·32	14	0·53	3·08
Invercargill	2·00	16	0·60	3·96
Puysegur Point	6·94	19	2·31	7·45
Half-moon Bay	2·84	19	0·78	4·74

Map of Ahuriri Lagoon.—The scale of the map printed on page 70 of this issue is 100 chains to 1 inch.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith Letters should be addressed to the Editor.

FEEDING POTATO SHAWS AND TUBERS TO DAIRY STOCK.

"NEW CHUM," Rotorua:—

Will you kindly advise me if potato shaws and tubers are suitable for feeding to dairy cows and calves. If not, what are the objections to their use?

The Live-Stock Division:—

To feed the tops or stems of potato plants would be disastrous, as they are poisonous. The tubers themselves are dangerous unless very carefully dealt with. A very small quantity would have to be fed at first and gradually increased, and then sudden stoppage of the supply avoided. We would not recommend this feeding for calves and not even for cows, as we do not consider potatoes suitable for dairy stock. Potatoes ferment very readily in the stomach, and cause serious indigestion and gas formation if fed in too large quantities.

PRAIRIE-GRASS.

R. M. T., Napier:—

I shall be obliged if you can give me some information about prairie-grass. Some time ago I read that by sowing 90 lb. per acre it could be fed intensively or otherwise, if given a complete rest during the latter end of summer.

The Fields Division:—

Prairie-grass will not stand heavy close continuous grazing, and is more suited to haying conditions, although grazing can be carried out with discretion. This plant seems to adapt itself to certain localities, and on the whole prefers a sandy free loam. The quantity sown per acre is usually about 60 lb. In order to ascertain whether prairie-grass would adapt itself to your conditions, we would suggest that a small area be laid down as a trial before going to the expense of endeavouring to develop any large area.

AREAS OF GRASSLAND TOP-DRESSED, 1930–32.

THE following table shows the areas of grassland in New Zealand top-dressed once or more with artificial fertilizers, and with lime, during the twelve months ended 31st January, 1931 and 1932:—

Land District.	1930–31.		1931–32.	
	Top-dressed with Fertilizers.	Top-dressed with Lime.	Top-dressed with Fertilizers.	Top-dressed with Lime.
	Acres.	Acres.	Acres.	Acres.
North Auckland ..	408,978	54,727	365,386	52,839
Auckland	883,302	168,926	847,154	187,351
Gisborne	43,059	1,835	33,954	913
Hawke's Bay	123,232	9,223	80,574	9,386
Taranaki	327,914	32,862	295,658	26,870
Wellington	307,290	39,761	241,820	38,513
Nelson	26,773	6,362	21,463	4,617
Marlborough	20,376	1,847	12,265	842
Westland	7,349	3,504	7,868	3,780
Canterbury	93,159	40,681	55,083	21,216
Otago	62,702	23,114	32,579	10,531
Southland	128,304	56,036	73,868	29,791
Dominion ..	2,432,438	438,878	2,067,672	386,649